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OPPORTUNITIES FOR RESEARCH IN BOTANY OFFERED BY AMERICAN INSTITUTIONS.

ELEVEN years ago the GAZETTE published what was called a "laboratory number," in which were described the facilities of some of the institutions which had equipped laboratories for instruction in elementary botany. Within the last decade a considerable number have not only provided for elementary work but also for the advanced work and research leading to a doctor's degree.

In conversation with two of the editors of the GAZETTE last summer, Professor MacDougal suggested that it would be of advantage to botanists for the editors to bring together a statement of the opportunities for research now afforded by American laboratories. To present an absolutely complete statement of this kind is obviously an almost impossible task, since there is no sharp line between research in pure and applied botany, and there are many advantages for original research in connection with the agricultural experiment stations. It seemed best, therefore, to limit the present account to the institutions conferring a doctor's degree. This excludes such important institutions as the National Herbarium, the Missouri Botanic Garden, and others, whose extensive libraries and collections are freely open to all qualified students.

The degree Ph.D., or Sc.D., is conferred by the institutions represented in the following pages only in recognition of capac-

ity for original research as shown by a thesis approved by the faculty. A residence of at least one year, and in some cases two years, at the university conferring the degree is required. Upon the presentation of a satisfactory thesis the candidate is admitted to examination, which must show familiarity with the general subject of botany, and in most institutions with one or two allied subjects as minors. Usually no precise requirements are stated, but the minimum time in most institutions is three years of graduate work.

In order to elicit the information desired the editors of the GAZETTE selected seventeen institutions where they personally knew of the existence of well equipped laboratories and a vigorous head of the botanical department. To the head of the department was addressed a letter of inquiry, in which, to guard against misunderstanding, the following language was used:

> We wish to know what work in botany a student can obtain in your institution this year, who should come with three years of training in general botany and ask to enter for the doctor's degree. This information is intended not for the glorification of any university, but to give the actual status of the facilities for graduate work in American laboratories. It is not intended to give what the instructor might do had he more time, a better library, and more apparatus, but what he can do actually with his present limitations. This is making an unusual demand upon your time, but we are confident that you will aid us in making this statement as full and accurate as possible.
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> In order that no essential point may be omitted we would suggest that not only the kind of work that is possible be described, but definite information given as to strength of library and collections, and also garden and greenhouse facilities. We shall take it for granted that the ordinary appliances are available.

Replies were received from all those addressed. Two of the seventeen replied that the institution did not offer the doctor's degree in botany at present. The reply from another stated no subjects in which research might be undertaken, so that it was not possible to include it in the summary given below. In addition to the information conveyed by letter we have used data derived from the handbook for graduate students, *Graduate Courses*, for 1896–7, and from the catalogues of the several institutions. All the data obtained have been arranged under

the headings: staff; subjects offered; library; greenhouses and garden; collections; publication; remarks.

In giving the "staff" we have included all those concerned in instruction, so far as known to us, in order to indicate something of the strength of the department. For the same purpose we have also stated the number of volumes in the general library. While botanical works bear no necessary ratio to the whole, this furnishes a datum for estimate and for interpretation of the statements regarding the botanical library. In some cases the number of botanical works is stated, which is most direct and satisfactory.

It will be understood that under "subjects offered" are listed those divisions of botany within which the staff may be considered competent to suggest problems for research, and for which suitable facilities are now at hand. No account is taken here of any courses of instruction, whether offered to graduates or to undergraduates, though these may be an important factor in preparation for the examination.

Channels for publication are abundant; but certain institutions have journals or bulletins which are especially established to receive the results of research prosecuted at them. In such cases these have been indicated under the heading "publication."

In the following pages the institutions are arranged alphabetically. As far as possible the statements are given in the words of the writers.

University of California.

Staff.—William A. Setchell, Ph.D., Professor; W. L. Jepson, Ph.B., Instructor; W. J. V. Osterhout, A.M., Instructor; J. Burtt Davy, Assistant in the Botanic Garden; C. P. Nott, Ph.B., Graduate Assistant.

Subjects offered.—Cryptogamic Botany. The cryptogams of California offer exceptional opportunities for research, and many simpler problems are presented for original investigation. This work will be confined, during the year 1896–7, almost exclu-

sively to the algæ, in connection with the special work of the instructor.—Professor SETCHELL.

PHÆNOGAMIC BOTANY. Special problems requiring the original investigation of some particular order or smaller group of flowering plants. Work in the field as well as in the laboratory required.—Mr. JEPSON.

HISTOLOGY AND CYTOLOGY. Special problems in histology or cytology.—Mr. OSTERHOUT.

Library.—In the university library (65,000 volumes, 32,000 pamphlets) and that of the Academy of Sciences in San Francisco (nine miles away but readily accessible for a small fare) the important botanical works and periodicals are fairly well represented. For systematic work upon phænogams, and upon certain groups of cryptogams the literature is fairly complete. The works upon cytology are also well represented. There is some considerable representation of works upon vegetable histology and physiology.

Greenhouses and garden.—The new conservatory, recently completed, is a structure of iron and glass, and embodies the latest improvements; extreme length 170 feet, greatest width 60 feet, area about 7000 square feet; five subdivisions arranged for different temperatures. Especially for use of Agricultural Department.

The botanical garden occupies about seven acres of ground, of which about four have been laid out into garden plots. The remaining acres are in various degrees of preparation, but have already been planted with different shrubs and young trees. Altogether there are growing in the garden about 1500 species of plants, of which 1000 are perennial species and well established. About 1000 of these are Californian. Besides these there is a collection of seeds of about 2000 species, the greater part of them native. The plants of many different climates grow well out of doors. The collections of Australian, Chilian, Japanese, Chinese, African, and European species in common cultivation upon the university grounds and in the garden of useful plants of the Agricultural Department afford a rare opportunity for obtaining material.

Collections.—The herbarium of the university has been gathered by gifts and purchases around the nucleus of about a thousand species contributed by the State Geological Survey. The number of sheets now amounts to over 20,000 and there is sufficient unmounted material, which is being cared for as rapidly as the facilities will permit, to bring the number up to nearly 30,000. About two-thirds of these are given up to North American species. The remaining third is divided among the species of South America, Asia, Africa, Europe, and Oceanica.

The cryptogamic side of the herbarium has of late been especially developed, and already contains about 4000 specimens of ferns, mosses, hepatics, marine algæ, fungi, etc. The valuable collections of algæ, fungi, and lichens of Professor Setchell are deposited with the Botanical Department, and are accessible to advanced students.

Publication.—Short papers may be published in *Erythea*, a monthly journal edited by Mr. Jepson.

Longer papers and monographs requiring expensive plates may be published in the botanical volumes of *Proc. Cal. Acad. Sci.*, of which Professor Setchell is one of the editors.

THE UNIVERSITY OF CHICAGO.

Staff.—John M. Coulter, Ph.D., Head Professor; Edwin O. Jordan, Ph.D., Assistant Professor of Bacteriology; Bradley M. Davis, Ph.D., Instructor; Charles J. Chamberlain, A.M., Assistant; four Fellows who are members of the instruction force.

Subjects offered.—1. Special morphology of spermatophytes. —Professor COULTER.

2. Special morphology of algæ.—Dr. DAVIS.

3. Ecology, especially with reference to the problems of the dunes.—Professor COULTER.

4. Taxonomy of any group of spermatophytes.—Professor COULTER.

5. Bacteriology.—Dr. JORDAN.

Library.—General library 310,000 volumes, 180,000 pamphlets. The strictly botanical library contains about 3000 vol-

umes, including complete sets of numerous periodicals, and several thousand pamphlets (not yet catalogued). The Newberry and Crerar libraries, both easily reached, add largely to the library facilities. A very complete list of current books and periodicals is received in exchange for the BOTANICAL GAZETTE.

Greenhouses and garden.—There are no greenhouses at present belonging to the university. The large houses in Washington Park, and the extensive planting both in Jackson and Washington parks (a few blocks east and west of the university respectively) supply almost unlimited material.

Collections.—The entire herbarium and library of Head Professor Coulter have been purchased by the university, containing a very full representation of the vascular plants of North America, and their literature. The collection is especially rich in types and standard sets.

Publication.—The BOTANICAL GAZETTE, published by the university, is the natural avenue for publication of papers from the department. Books may be issued by The University of Chicago Press.

Remarks.—A botanical club holds weekly meetings to discuss current research and publications.

The foregoing relates only to work offered this year. Enlarged space, facilities and staff, will be provided after the completion of the Hull Botanical Laboratory, now in course of construction.

COLUMBIA UNIVERSITY.

Staff.—Lucien M. Underwood, Ph.D., Professor; Carlton C. Curtis, Ph.D., Tutor; J. K. Small, Ph.D., curator of herbarium.

Subjects offered.—1. Anatomy and morphology both of spermatophytes and cryptogams. 2. Taxonomic work in nearly all groups. 3. Palæobotany, offered by the department of Geology.

Library.—General library, 225,000 volumes. The botanical portion contains about 4000 volumes and 5000 pamphlets shelved in herbarium room, besides general scientific series and serials containing botanical matter accessible in the general library.

The library of the New York Academy of Sciences, very rich in general scientific serials, is one floor above the herbarium.

The university collection contains almost complete files of nearly every serial ever published on botany, besides general works and special works. The cryptogamic portion is especially full on ferns, mosses, hepatics, lichens, and fungi.

Greenhouses and garden.—A greenhouse at Morningside, with some facilities for supplying living plants and space for simple physiological research. On future facilities, see below.

Collections.—(*a*) The herbarium contains about 600,000 specimens, being one of the largest in America; additions are at present made to it at the rate of about 20,000 specimens a year. It comprises: (1) The collections accumulated by Dr. Torrey, which came into the possession of the university at his death in 1873. (2) The collections of Professor C. F. Meisner, of Basle, Switzerland, presented to the university about the time of Dr. Torrey's death, by Mr. John J. Crooke. (3) The collections of Dr. A. W. Chapman, of Apalachicola, Florida, presented by Mr. Crooke at the same time, containing the types illustrating Dr. Chapman's "Flora of the Southern United States." (4) The mosses of the late C. F. Austin. (5) The mosses of the late Dr. J. G. Jaeger, recently acquired. (6) The fungi of J. B. Ellis, about 75,000 specimens, recently acquired for the New York Botanical Garden; in addition there are about 25,000 specimens of fungi in the general collections. (7) Miscellaneous accumulations since Dr. Torrey's death, now making up more than one-third of the whole collection. The herbarium is rich in types of species described by Dr. Torrey, Professor Meisner, Dr. Chapman, Dr. Asa Gray, Mr. Austin, Professor Britton, and Dr. Morong. The various collections are now all arranged in a single series, but each sheet is identified by a designative label or stamp. There are also extensive collections of fruits, seeds, woods, and material illustrating economic botany, placed in cases and drawers.

(*b*) The Jesup collection of woods in the American Museum of Natural History.

(*c*) Extensive economic collections and the Canby and Wood herbaria at the New York College of Pharmacy under the supervision of Professor Rusby.

(*d*) The Morong herbarium at Barnard College.

Publication.—The *Bulletin* and the *Memoirs* of the Torrey Botanical Club, and the *Transactions*, the *Annals*, and the *Memoirs* of the New York Academy of Sciences offer opportunities for papers; the University Press of Columbia University will issue books.

Remarks.—After the completion of the museum building of the New York Botanical Garden, the graduate research work will be conducted at that place where all the botanical facilities are to be centered.

Cornell University.

Staff.—George F. Atkinson, Ph.B., Professor; W. W. Rowlee, Sc.D., Assistant Professor; E. J. Durand, Sc.D., Instructor; K. M. Wiegand, B.S., Assistant; B. M. Duggar, A.M., Assistant.

Subjects offered.—1. Experimental morphology; with special reference to (1) sterilization of sporogenous tissue, (2) transformation of sporophylls, (3) homology of plant members, (4) teratological questions.

2. Experimental physiology, with special reference to the measurement of osmotic pressures.

3. Ecology, with special reference to relation and distribution of plants under peculiar conditions in central New York; distribution of fungi on hosts.

4. Comparative embryology; (1) embryology of sporophytic organs; (2) embryology of gametophytic organs; (3) accompanying cytological problems.

5. Morphology of fungi; monographic studies of certain genera.

6. Development of fungi; special and comparative studies of genera.

7. Structure and development of algæ; special facilities for the study of cystocarpic development in Florideæ.

8. Cytology in the broad sense.

9. Comparative histology; with special reference to development of vascular tissue, and secondary thickening of the cambium; tissues of seedlings; relation of histology to taxonomy.

10. Special morphology of higher plants, with reference to special forms assumed by different members.

Library.— General library contains 190,000 volumes and 50,000 pamphlets. A large number of current journals are received. Botany has a good showing in the library, but it would be impossible to give an accurate or even approximate statement since so many of the important articles are found in transactions and proceedings of societies.

Greenhouses and garden.— Five different houses of different temperatures, with a variety of exotic plants, some native plants, space for growing plants in physiological experiments, and material for illustration and use in the laboratories.

A garden for illustrations and for growing plants, to supply certain of the wants in the laboratory, as well as for experimental purposes.

Collections.— A small but growing herbarium of about 15,000 species.

Harvard University.

Staff.—George L. Goodale, M.D., LL.D., Professor Nat. Hist. and Director of Botanic Garden; Wm. G. Farlow, M.D., LL.D., Prof. Crypt. Bot.; Roland Thaxter, Ph.D., Asst. Prof. Crypt. Bot.; H. L. Jones, A.M., Instructor; Arthur B. Seymour, M.S., Asst. in Crypt. Herb.; Albert R. Sweetser, A.M., Asst.; Frederick O. Grover, A.B., Asst.; Jos. W. Blankinship, Asst.

Subjects offered.— 1. Structure and development of phanerogams. 2. Physiology. 3. Taxonomy of pteridophytes and phanerogams. 4. Economic and medical botany.—Professor Goodale.

5. Structure and development of cryptogams.—Professors Farlow and Thaxter.

In the case of candidates for degrees, who are generally young men just beginning their botanical career, it has been the practice in the cryptogamic laboratories to set them to work on some histological or developmental subject rather than upon descriptive systematic work; it being the opinion that, while a beginner may be able to accomplish something valuable in the first-named field, purely systematic work worthy of publication cannot be expected except after a number of years have given a broad, practical knowledge and matured the judgment. In the case of candidates for a degree, students are allowed to select subjects in accordance with their individual tastes, provided such subjects can be properly worked up in the two or three years of candidacy.

Besides candidates for the doctor's degree, the university offers the means for research to persons specially qualified who reside at the university, for the purpose of pursuing some special piece of work. These are in general visiting botanists and specialists who remain for periods varying from a few days to a few months, and they are often occupied with systematic work; to such persons the libraries are freely accessible, and they are allowed to consult the herbaria under the charge of the curators.

Library.—The general library of the university contains 468,000 volumes and 450,000 pamphlets. Students have free access to the large special botanical libraries in Cambridge and Boston and the private libraries of the instructors. The former furnish valuable series of journals and proceedings and the latter special papers and monographs. The special library at the Gray Herbarium contains 9000 volumes and pamphlets.

Greenhouses and garden.—The greenhouses are located at the Botanic Garden, half a mile from the general laboratories. Special laboratories are available at the garden, when desired. The plant houses are arranged for various temperatures and conditions.

The garden embraces seven acres fully planted, and contains over 5000 species.

Collections.—If the material to be studied is histological, the student is provided with alcoholic, or dried material, of which a considerable amount is kept on hand to illustrate certain points which sooner or later should be investigated. If the subject requires living material, the country near Cambridge and the seashore furnish abundant material.

The herbaria at the museum are rich in fungi, algæ and lichens, and at the Gray Herbarium are valuable collections of higher cryptogams and mosses. The lichens include the Tuckerman collection together with a number of other native and exotic collections; the fungi include the Curtis collection and a large series of published exsiccati; and the algæ are represented by several valuable foreign collections and exsiccati, besides the large collection of American algæ.

There are extensive collections of economic products in the museum.

The Gray Herbarium of over 200,000 sheets, and rich in types, affords extraordinary opportunity for research in phanerogamic taxonomy. It also contains several important collections of mosses.

Remarks.—A botanical club holds fortnightly meetings.

The staff of the Gray Herbarium is not included above, as its duties are not primarily instructional.

University of Illinois.

Staff.—T. J. Burrill, Ph.D., LL.D., Professor; G. P. Clinton, M.S., Instructor; C. F. Hottes, M.S., Assistant.

Subjects offered.—1. Taxonomy of fungi and fresh water algæ. 2. Bacteriology. 3. Histology. 4. Physiology.

Library.—General library of 28,200 volumes and 6200 pamphlets contains about 2000 volumes strictly botanical. Includes complete sets of all the prominent European and American periodicals (save the English illustrated and expensive publications), and most of the standard works on physiological, pathological and economic subjects. The fungi are especially well represented.

Greenhouses and garden.—There is no garden. Greenhouses on the university grounds contain plants of many kinds, not collected for any particular line of study. The facilities of the houses for propagation, growth in pots, etc., are available. Attached to the laboratory for vegetable physiology is a small conservatory 14 × 19 ft., two stories high, with aquarium tank 6 × 14 ft. in lower room.

Collections.—The herbarium is small (about 25,000 species, mounted) but is rich in parasitic fungi. There is a very nearly complete set of Illinois flowering plants and ferns. The grasses are well represented.

Remarks.—A biological station established at Havana, Ill., on the Illinois river, contributes special facilities for investigations upon aquatics.

JOHNS HOPKINS UNIVERSITY.

Staff.—J. E. Humphrey, S.D., Lecturer.

Subjects offered.—Morphology.

Library.—The library of Capt. John Donnell Smith (which has been offered to the university) is near by and is accessible to properly prepared students. It is rich in the literature of the taxonomy of spermatophytes, and in serials.

Besides this library, those of the neighboring Peabody Institute, of the university (76,000 volumes and 55,000 pamphlets), and of the instructor, contain much important botanical literature. Altogether, the most important books, full sets of nearly all the journals, and of the proceedings of the chief learned societies are readily accessible.

Greenhouses and garden.—None.

Collections.—The collections in the care of the university are small, comprising the Schimper herbarium of European and African phanerogams, the local collections of the Naturalists' Field Club, the Fitzgerald collection of mosses, and the private herbarium of the instructor, chiefly of thallophytes. The herbarium of Capt. Smith is also accessible to students.

Remarks.—Graduate work in botany is a matter of recent

development at the Johns Hopkins University, and the number of students who can be accommodated is limited.

LELAND STANFORD JUNIOR UNIVERSITY.

Staff.—Douglas H. Campbell, Ph.D., Professor; Wm. R. Dudley, M.S., Professor; Walter R. Shaw, A.M., Instructor.

Subjects offered.—Life-history of one of the lower monocotyledons, hepatics, or pteridophytes; comparative organogeny; special problems in cytology; systematic study of special groups of native plants.

Library.—The university library consists of 30,000 volumes, and 10,000 pamphlets. In botany it contains standard works of general character up to date, and complete sets of several of the more important journals. It is supplemented by private libraries of professors, especially rich in separates pertaining to special subjects.

Greenhouses and garden.—There are two greenhouses on the grounds, but not conveniently situated, so that they are little used. Material is chiefly derived from the wealth of vegetation growing out of doors, both wild and cultivated. The university tract of 8000 acres embraces a great variety of surface, and furnishes an abundance of materials of all sorts. Extensive plantations of exotic and native plants, including a great variety of trees and shrubs, offer unusual opportunities. Moreover, the mountains and seashore are both readily accessible.

Collections.—The herbarium now contains about 25,000 species. The collections and library of the California Academy of Sciences at San Francisco (33 miles away) are also available.

Remarks.—The Hopkins seaside laboratory at Pacific Grove, an adjunct of the biological department of the university, offers especially good facilities for the study of the rich marine flora.

UNIVERSITY OF MICHIGAN.

Staff.—Volney M. Spalding, Ph.D., Professor; F. C. Newcombe, Ph.D., Assistant Professor; J. O. Schlotterbeck, Ph.D.,

Assistant Professor; Jas. B. Pollock, M.S., Assistant; Fannie E Langdon, B.S., Assistant.

Subjects offered.—Morphology. Physiology.

Library.—General library contains 100,000 volumes, 18,000 pamphlets. The special botanical books are shelved in the laboratory. They comprise sets of journals and other periodical literature and monographs.

Greenhouses and garden.—Space is provided in a neighboring conservatory and garden where plants under investigation are cared for by an attendant.

Collections.—The laboratory contains a large collection of alcoholic material and an herbarium of about 100,000 sheets representing about 14,000 species. The collection of fungi includes Ellis and Everhart, Briosi and Cavara and other valuable sets, and a large representation of species occurring in Michigan. Arrangements are also made by which abundant marine and tropical material is provided when needed.

Remarks.—The income of the laboratory makes it possible to promise an investigator anything that he really needs in the way of material and apparatus.

A journal club of a dozen or fifteen instructors, investigators, and advanced students meets weekly for reports on current literature.

University of Minnesota.

Staff.—Conway MacMillan, A.M., Professor; D. T. MacDougal, A.M., M.S., Assistant Professor; F. Ramaley, M.S., Instructor; A. A. Heller, Instructor; Josephine E. Tilden, B.S., Instructor.

Subjects offered.—Comparative morphology, anatomy and embryology; ecology; cytology; algology and mycology; ecologic distribution.

Taxonomy of Spermatophyta and Pteridophyta.

Physiology, with special reference to irritability, the directive and formative influence of environmental factors.

Special research. Students with expert knowledge are

encouraged to select special problems and carry them along to some useful and adequate solution. For such investigations it is the policy of the institution to provide any reasonable facility in the way of special apparatus, material and literature. The university does not hesitate at expense if there be the opportunity of developing some important research under its supervision.

Library.—The general botanical library contains about 2200 bound volumes and 3800 separates. Especial care has been exercised to procure complete sets of periodicals, and practically all the important botanical journals, with the exception of *Curtis' Magazine*, *Oesterreichische Botanisches Zeitschrift* and *Nuovo Giornale Botanico Italiano*, have been purchased entire or are easily available. Certain special fields are well represented in the collection, but it is the plan of the department to furnish exhaustive series of literature only when a definite problem is to be settled. Of course all the botanical bibliographies are at hand, and there is absolutely no reason in any given case why everything that has been done upon any given topic should not be brought to light.

The physiological section includes about 200 volumes and 1000 separates shelved in the laboratory. Literature not purchasable may be obtained by loan from a German institute by a personal arrangement of the instructor.

The mycological and algological collections are likewise shelved in the respective laboratories, and a large section of the taxonomic library is shelved in the herbarium.

Collections.—Besides several hundred specimens of wood from different parts of the world and as many jars of alcoholic and formalose material, the herbarium with its 200,000 specimens (in round numbers) is an important part of the equipment. It is being developed upon the broadest basis. Plants of all orders and from every part of the world are either already included in its cases or are among its desiderata. It now serves as a very adequate reference collection for North American taxonomy and is rich also in Mexican, European, African, and Asiatic material.

It continues to increase rapidly in size and value and, as in the library, efforts will be made to supply as full an illustrative series of plants as possible, for whatever special research may be taken up.

Greenhouses and garden.—The plant house (20×40 feet) is inadequate at present but suffices for the maintenance of some 300 species of plants that are used in morphological work. Besides its further function as an adjunct to the laboratory of plant physiology, its principal use is as a depot for native plants freshly taken from their stations. There is no garden.

Publication.—*Minnesota Botanical Studies*, a quarterly or occasional series of papers, offers a medium of publication for the researches of the department. Plates are provided as needed and separates are struck off when requested.

Remarks.—In morphology and ecology the university offers to a limited number of graduate students every facility desired in the way of instruments, reagents, literature and material. There are accommodations at present for twenty. Problems in cytology, in embryology, and in anatomy are particularly kept in mind by the instructor. Special laboratories, three in number, are at the disposal of graduates in these lines. Collecting trips to different parts of the state can be arranged; cameras are provided for ecologic work, and camping outfits are furnished those who desire to spend some time in the field.

The department is prepared to assist in the taxonomic revision of any North American genus or family, and either has or will procure a full set of material for study. An exchange bureau is maintained in connection with the herbarium, through the correspondence of which a large number of American collectors can be reached.

The accommodations in physiology are sufficient for six students. The instructor has in hand notes and material upon which a student may profitably engage in the investigation of certain problems in the formative and directive influence of external factors, irritability to contact and impact, transmission of impulses, curvatures, growth correlations, and the physiology

of storage tissues and color layers. Beside the usual physiological apparatus, a number of pieces of more or less complex apparatus of special design, which were constructed for the solution of problems under investigation, have been accumulated. Such appliances are often found to be of very great value in other work. New and necessary apparatus may be purchased, and that designed by the investigator can be made very promptly by the instrument makers to the electrical and physical departments.

The University of Nebraska.

Staff.—Charles E. Bessey, Ph.D., Professor; Frederic E. Clements, B.S., First Assistant; Cornelius L. Shear, Second Assistant; Edna L. Hyatt, Botanical Artist.

Subjects offered.—1. Plant morphology. Work in several lines of morphology has been given successfully for several years.

2. Systematic botany *A*, being the study of a selected group of plants. Here the student will find ample material for the study of all the important groups (classes, most orders, and many families). The herbarium has been built up in such manner as to represent as fully as possible all the important groups.

3. Systematic botany *B*, being the study of a local flora, and the preparation of a catalogue. The plains, and the mountains to the west, afford ample facilities for this work, supplemented by the quite full herbarium of the Botanical Survey of the state.

4. Phytogeography. The collections made by the Botanical Seminar afford ample material for profitable study.

Library.—The university library contains 34,000 volumes, and the botanical library about 2000. In the university library 467 periodicals are received, in the botanical library 43. Of many of these it has complete sets; of others its files run back ten or twelve years; while of still others the files are but a few years old.

Greenhouses and garden.—There is a steam-heated greenhouse of 4200 sq. ft. of glass, with tank for aquatics; no garden.

Collections.—The herbarium contains from 70,000 to 80,000 specimens, and includes exsiccatæ by Wittrock and Nordstedt, Rabenhorst, Le Jolis, Ellis and Everhart, Thueman, M. A. Curtis, Romell, Linhart, Sydow, Shear, Seymour, Tuckerman, Stenhamer and Fries, Massalongo, Seymour and Cummings, Gottsche and Rabenhorst, Austin, Underwood and Cook, Heller, A. H. Curtiss, Harvey, Rydberg, etc. The quite complete herbarium of the Botanical Survey of Nebraska, by the Botanical Seminar, is also available for study.

Publication.—Ample opportunity for publication is afforded by "Contributions from the Botanical Department of the University of Nebraska," "Bulletin of the University Experiment Station," "University Studies," "Reports of the Botanical Survey," and "Flora of Nebraska." The two last are published by the Botanical Seminar.

Remarks.—A shop for the construction of apparatus is equipped with tools, lathe, anvils, etc.

The Botanical Seminar is a very active organization, largely interested in the study of the state flora. At its bimonthly meetings botanical papers are read and critically discussed. Admission to membership is attained upon passing an examination in the anatomy and morphology of the spermatophytes, morphology and development of the lower plants, embryology of spermatophytes, taxonomy, bibliography, etc.

PURDUE UNIVERSITY.

Staff.—Stanley Coulter, Ph.D., Professor of Biology; J. C. Arthur, Sc.D., Professor of Physiological and Pathological Botany; Katherine E. Golden, M.S., Instructor in Biology; Severance Burrage, B.S., Instructor in Bacteriology; William Stuart, B.S., Assistant.

Subjects offered.—Histology; taxonomy of spermatophytes.—Professor COULTER. Physiology; ecology; pathology.—Professor ARTHUR. Bacteriology.—Mr. BURRIDGE.

Graduate work in these subjects is carried on with accom-

modations provided jointly by the university and the Agricultural Experiment Station.

Library.—The botanical resources of the university library (8000 volumes) are only moderate. The private library of the professor of physiological botany, kept at his residence, contains about 800 bound volumes and 2000 pamphlets, and is especially rich in works on physiology, pathology and fungi. The works have been purchased as need for them arose, and additions are being constantly made. It is open freely to the use of students.

The botanical part of the library of the station is also available, and consists of about 200 volumes, of which about one-half is embraced in nearly or wholly complete sets of *Berichte der deutschen botanischen Gesellschaft*, *Botanisches Centralblatt*, *Centralblatt für Bakteriologie und Parasitenkunde*, and Just's *Botanischer Jahresbericht*.

Greenhouses and garden.— From the general laboratory a door opens directly into the greenhouse, which may be considered as a glass covered portion of the laboratory, being on the same level, with tight floor and table topped benches. The greenhouse is small, but is entirely devoted to research work, the usual collection of conservatory plants being almost wholly excluded. It is in two independent parts, permitting different degrees of temperature to be maintained. The university conservatories, not far away, contain a good general assortment of plants, which may be drawn upon if required.

The garden has but a temporary value, and consists of a plot of ground a few steps from the laboratory, having a few shrubs and perennials, but available for the accumulation or cultivation of plants required for an investigation. The glass covered vegetation house is 20×50 feet, but is serviceable chiefly for summer work.

Collections.—The herbarium of the biological department contains about 6500 mounted sheets of phanerogams, and is especially rich in the plants of Indiana. The herbarium of the professor of physiology, including probably six thousand species, is only in small part readily accessible, being unmounted. The

mounted part consists of about 1300 sheets of phanerogams and 1600 sheets of fungi, nearly three-fourths of the latter being Uredineæ.

Publication.—The *Bulletin* of the Agricultural Experiment Station has provided for the publication of research work.

Remarks.—A machine room, provided with a lathe and assortment of iron and woodworking tools, and a skilled mechanic when required for making needed apparatus, is maintained.

Smith College.

Staff.—William F. Ganong, Ph.D., Professor; Grace D. Chester, B.S., Instructor in Cryptogamic Botany.

Subjects offered.—Morphology; ecology.

Library.—Contains all ordinary reference works; is being strengthened rapidly, particularly in morphology and ecological phases of physiology. The Forbes Library, richly endowed, practically on the college grounds, buys the more expensive works if not too technical. Amherst Agricultural College library (seven miles away with railroad between) is rich in complete sets of botanical and agricultural journals and proceedings, and is accessible freely to all students.

Greenhouses and garden.—The college possesses a garden, with systematic and ecological sections being rapidly developed. Some 800 species are in cultivation out of doors. There is a nursery available for experiment. The range of greenhouses is in every respect thoroughly efficient, and fairly stocked, particularly with plants selected to illustrate morphological and ecological principles. Includes (*a*) experiment house 20 × 30 ft. with special stages directly on brick piers; attached to it is a small laboratory 20 × 15 ft.; (*b*) cool temperate house 20 × 30 ft.; (*c*) acacia and succulent house, 20 × 17 ft.; (*d*) palm house 56 × 35 × 25 ft. high; (*e*) tropical house 32 × 20 ft.; (*f*) warm temperate and aquatic house 45 × 20 ft., propagating house 5 × 60 ft., working house, etc. The entire range is exclusively for botanical purposes, and any part of it and its stock is

available for investigation, and materials therefore can be grown in any quantity and with all proper conditions.

Collections.—The herbaria are small; the phanerogams just under 4000 sheets; the cryptogams 2500; both general.

Remarks.—Smith College does not especially encourage graduate work at present, as it is devoting its main resources to strengthening its undergraduate course in all directions. Nevertheless it does not decline to receive graduate students and it confers the Ph.D. degree upon the conditions usual in institutions of the first rank.

UNIVERSITY OF WISCONSIN.

Staff.—Charles R. Barnes, Ph.D., Professor of Botany; H. L. Russell, Ph.D., Professor of Bacteriology; L. S. Cheney, M.S., Assistant Professor of Pharmaceutical Botany; W. S. Marshall, Ph.D., Assistant Professor of Biology; W. D. Frost, Assistant in Bacteriology.

Subjects offered.—1. Physiology, especially nutrition; Bryology.—Professor BARNES.

2. Agricultural and Dairy Bacteriology.—Professor RUSSELL.

3. Histology, especially of medicinal plants.—Professor CHENEY.

Library.—The university library is deficient in many respects. It contains about 45,000 volumes and 10,500 pamphlets, of which about 1000 and 200 respectively are especially botanical, including full sets of many important periodicals. Such as are most used are shelved at laboratories. It is quite complete in the taxonomy of bryophytes. It is supplemented by the libraries of the State Historical Society and the Academy of Sciences, Arts, and Letters (about 200,000 volumes and pamphlets), which contain many sets of transactions, etc., and some of the expensive general works; and by the private libraries of the professors, containing many separates.

Greenhouses and garden.—The physiological laboratory opens into a small conservatory 9 × 18 ft. for experimental work only. Large greenhouses belonging to the Agricultural Department

supply growing material at all seasons, but are too far away (half a mile) for direct use. There is no garden. About four acres of campus, a hundred yards from laboratory, are kept in original wild state with native trees and undergrowth and supply material during the growing season. Adequate supplies of alcoholic and formalin specimens are kept for research in histology and morphology.

Collections.—The general herbarium contains about 10,000 species. Special attention is given only to building up the herbarium of Wisconsin plants and of North American mosses. The latter is almost complete and has many sets of exsiccati.

Publication.—The *Bulletin* of the university of Wisconsin, Science Series, and the *Bulletin* of the Agricultural Experiment Station afford special facilities for publication.

Remarks.—The university creamery furnishes unusual opportunities for research in dairy bacteriology upon a commercial scale. A journal club holds weekly meetings.

SOME NEW SPECIES OF MINNESOTA ALGÆ WHICH LIVE IN A CALCAREOUS OR SILICEOUS MATRIX.

JOSEPHINE E. TILDEN.

(WITH PLATES VII–IX)

DURING the past three seasons there have been observed near Minneapolis several species of algæ which deserve attention from their peculiar manner of life, since they occupy not the surface but the interior of rock formations. They exist, therefore, under conditions of low illumination.

In the summer of 1894 a curious incrustation was noticed lining the sides of an old sunken tank which had formerly been used in connection with a rendering factory. The tank is situated on the eastern bank of the Mississippi river, two miles below this city. It is nearly forty feet square and six to nine feet deep, having a muddy bottom. The walls are of boards standing upright side by side and driven in like piles. The incrustation extends from the surface of the water downwards to a distance of perhaps three feet, where, becoming thin and scaly, it gradually disappears. Its thickness in 1894 was in the neighborhood of 2^{mm}. By the following year there was an increase to 6^{mm}, and in the present season it has attained an average thickness of 10^{mm}.

The crust covering the southwest side of the tank varies in color. Dull and bright æruginous, steel and brownish tints predominate, the two latter corresponding most nearly to the shades *cæsius* and *isabellinus* as given in Saccardo's *Chromotaxia* A close view of the surface shows it to be indented by very minute pores or depressions, which may be compared roughly to the markings on some of the corals and other lime secreting sea animals (*pl. VII*).

Subjected to chemical tests the incrustation is found to be made up almost wholly of calcium carbonate in the amorphous form, and organic material. It is exceedingly porous, absorbing water readily when dry, and is also very friable.

A microscopical investigation shows the presence throughout the stratum of species of algæ belonging to the Cyanophyceæ. Three species are found to be constant, a Dichothrix and two species of Lyngbya. Numerous diatoms and scattered cells of Glœocapsa are also present. The difference in color of the surface of the stratum is found to be due to the position of the above three species. When the Dichothrix appears on the surface a shade of light brown with a tinge of pink is given, or at times a bright cæsius blue. The Lyngbyas occasion the æruginous tints.

The calcareous matrix contains constantly an organism evidently fungal in character and corresponding in all respects to the chlamydospore-bearing filaments of *Pseudohelotium granulosellum* as figured by Brefeld.[1] The extraordinary occurrence of this fungus I am quite unable to explain, and its origin and development in the matrix must receive further study before anything of importance can be said about it.

In general the relative positions of the three algal species are as follows: the Dichothrix possesses the widest range and is the most abundant of the three. It occurs farthest from the light in the older portions of the lime stratum, as well as at the surface. Its arrangement is for the most part zonal. The filaments are parallel and stand perpendicular to the plane of the stratum. The large Lyngbya does not extend downward so far as the Dichothrix. It prefers, evidently, the area just beneath the surface of the crust, but at times it reaches the extreme surface. Its filaments form a tangled network. As a rule the small Lyngbya is found at the top of the matrix and immediately below the surface. The lower filaments consist of empty sheaths.

The growth on the remaining three sides of the tank shows

[1] Untersuchungen, Heft 10, *pl. 12, fig. 26.*

a somewhat different structure (*pl. VIII*). The incrustation just described now appears as the substratum, its surface being covered by the thalli of *Chætophora calcarea*, which was distributed as no. 11 in *American Algæ, Century 1*.

The thalli project from the substratum. They form somewhat globose mounds, or later these are confluent into sharp ridges or shelves parallel to the surface of the water. These shelves may be compared in shape to a Polyporus and are peculiar in construction. The upper portion consists of the Chætophora thalli proper, being in color a chlorophyll green; the substructure is made up of the blue-green species, notably the larger Lyngbya, which causes the bright purplish-blue color. Evidently, in the beginning, the Chætophora thallus is solitary, has a globose form, and stands out at right angles to the substratum, thus presenting one side to the direct light of the sun, while the opposite side is in the shade. The Lyngbya seizing the opportunity offered for additional room and indirect light soon forms a growth upon the under side of the Chætophora thallus. This in turn takes advantage of the support given by the Lyngbya, which it uses as a substratum, and takes an upright position to receive on all sides alike the direct sunlight. Thus the two plants develop, keeping pace with and aiding each other, until eventually the above mentioned structure is formed. It may be said that the Lyngbya forms a shelf upon which the Chætophora thallus may rest, or that the Chætophora makes of itself a screen for the protection of the Lyngbya. This is a distinct and somewhat peculiar form of symbiosis.

For a time it remained a problem why the Chætophora should be confined to the three sides of the tank, while the blue-green plants occupied also the fourth side. With some difficulty the position of the inlet of the tank was located. It was found that the water enters in the corner facing the south, that it flows out again at the west corner in a stream a foot in width, almost immediately disappearing in the ground. From this it appears that there is a current along the southwest side of the tank. Elsewhere the water, while not stagnant, is not

subject to so much movement that it might be called running water. This then is the probable reason for the arrangement of the plants. The preference of Chætophora for quiet, pure water is known, while Lyngbya and Dichothrix flourish in waters either with or without a current.

The Chætophora thalli are strongly impregnated with lime and are hard, making decalcification necessary before examination under the microscope. The nature of the calcium carbonate in these thalli differs from that in the substratum. Here it appears in the form of crystal plates which, under the high power of the microscope, have a striated appearance. This results from the fact that they have running through them perforations or tubes corresponding in size and form to the Chætophora filaments. Branches of the Chætophora may be observed indeed entering these tubes and emerging at the opposite side of the crystal plate (*pl. IX, fig. 6*). If a longitudinal section be cut from a thallus and placed under the lens, the crystal plates being left intact, it will be seen that these pipes or tubes radiate from the center, following exactly the trend of the branches and for the most part containing the branches, though it is somewhat difficult to focus closely enough to observe the latter point with the thick crystals under the coverglass (*pl. IX, fig. 7*).

The Chætophora, as well as a thin growth of the blue-green plants, occurs on dead limbs which have fallen into the water from the trees on the banks. A few of the twigs taken out of the tank late in the autumn displayed after drying a violet tint on their under surface. This was caused by the presence of a small Chantransia, which, like the other algæ, was incrusted with lime. Its color when growing was probably green, since otherwise it would have been noticed before it was dry. It was accompanied by both the Lyngbyas, similar in all respects to those found in the stratum on the sides of the tank, with the exception that their cell contents had now assumed a bright violet color. In rare cases filaments were still found with the former æruginous tint, and some belonging to the larger species

had a brown color. The change in color from æruginous to violet may have some connection with the approach of cold weather. It was also noticed that the sheath of the larger Lyngbya had become corrugated or roughened and somewhat wider.

It is thought that these five algæ, which have just been described, are capable, either alone or in combination, of causing the precipitation of calcium carbonate. If the deposit is not formed in this way, it must be because the water contains a large quantity of calcium carbonate which is laid down as the result of evaporation. In this case these algæ have become adapted to a life within a calcareous envelope. As a matter of fact the water is not rich in carbonates. An analysis kindly made for me by Professor G. B. Frankforter shows the following results:

Total solids,	36 grains per gallon.
Calcium carbonate,	18 " " "
Calcium sulphate,	17.5 " " "
Sodium chloride,	trace.
Magnesium sulphate,	trace.

Another fact in favor of the supposition that the plants act as agents in the deposition is that the precipitation of calcium carbonate takes place only where the plants occur, and not indiscriminately upon every object exposed to the action of the water. A dead branch of a tree, after being in the water a year, was taken out to be preserved. The top and sides, as it lay in the water, were covered with a luxuriant growth of the several blue-green algæ and the Chætophora. On its under shaded surface the algæ would not live, nor was there a trace of lime to be found there. Again, the water has formed a ditch around the outside of the tank, deep and narrow, and therefore dark. For the latter reason no algæ grow on the back of the boards, and no deposit is formed there, though they are washed by the same water that circulates through the interior of the tank.

In certain waters at Mammoth Hot Springs, Yellowstone Park, where tourists suspend articles to be incrusted, the deposit coats

the entire surface of the object. In this case the lime is deposited through exposure to the air of water containing a great abundance of calcium carbonate, and not through the agency of algæ.

It has not been proved that any one of the blue-green species or the Chantransia is able by itself to produce a separation of the carbonate, but two facts show the Chætophora to be independent of the others in its secretion of lime; first, its thalli are not engulfed in the substratum, and, second, the calcium carbonate is deposited in crystal plates instead of amorphous particles.

Until recently the only additional inhabitants of the tank have been a species of moss, a Fontinalis, which formed a rich growth all over the bottom of the tank, and the little fresh-water shrimp, *Gammarus pulex*, which is present in exceedingly great numbers. During the latter part of the recent summer, however, the water has appeared less pure, and a heavy growth of Spirogyra spread over the surface. The blue-green algæ remain unchanged, but the Chætophora has not thrived so well. It must be noted that not all the plants growing in the tank possess the ability to cause the precipitation of lime. Neither the moss nor the Spirogyra show a tendency to do so.

In preparing a slide of the above material it is a good plan first to soak a piece thoroughly in water, then cutting off a thin section with a scalpel place in a dish of diluted hydrochloric acid and warm gently. When the bubbles of CO_2 cease forming, it can be mounted in water or glycerine. Before putting the cover glass in place, it is well to tease apart the filaments with needles, for the section is likely to be too thick for perfect transparency.

Dichothrix calcarea Tilden, Am. Alg. Cent. II. no. 165. 1896. (*pl. IX., figs. 1–3*)—In extended strata either on surface of calcareous matrix, giving it then a brownish or sometimes a light æruginous tinge, or in layers throughout the matrix. Filaments 9–12.5μ in diameter, erect, not rigid; pseudobranches appressed; sheath rather thin, hyaline; trichomes brown, sometimes æruginous, up to 10μ in diameter, for the most part

moniliform in lower portions, tapering to a point; articulations in lower portion of filament equal in length to diameter, shorter in upper portions; heterocyst basal, globose or depressed globose, diameter equal to or a little smaller than that of filament.

This plant does not seem to be very near any of the species of Dichothrix as described by Bornet and Flahault. The filaments are strongly agglutinated, and this with the moniliform character of the trichomes make it peculiar.

LYNGBYA MARTENSIANA **calcarea** Tilden, Am. Alg. Cent. II. no. 178. 1896. (*pl. IX., fig. 4*)—In extended strata throughout upper portions of calcareous deposit. Filaments elongate, straight, flexible, somewhat unequal in size, average 6.5–7.5μ in diameter; sheath very distinct, hyaline, smooth or rough; trichomes dull æruginous, violet, or rarely brown, frequently interrupted, not constricted at joints, not or very rarely attenuate at apex, 5–6.5μ in diameter; articulations 2–3 times shorter than diameter, average 2.5μ long; dissepiments often inconspicuous or marked with granules; apical cell rotund; calyptra none.

L. martensiana has been found only in thermal waters. The temperature of the water in the tank is 12° C. during the summer. The filaments of the species are somewhat larger and the articulations shorter than those of the variety, but otherwise the points agree very well.

Lyngbya nana Tilden, Am. Alg. Cent. II. no. 179. 1896. (*pl. IX., fig. 5*)—In extended strata on or near surface of deposit. Filaments 1.9μ in diameter, straight; sheath delicate, hyaline, smooth; trichomes very pale steel color becoming violet later in the season, not constricted at the joints; articulations 1.6μ in diameter, quadrate or 1.5 times the diameter in length; apical cell rotund.

In Gomont's monograph there are but four species of Lyngbya described whose size will permit of comparison with *L. nana*. Of these *L. Lagerheimii* is easily distinguished from it by the spiral filaments; *L. rivulariarum* by the constriction at the dissepiments, length of the articulations and habit of growth; *L. ochracea* differs in the peculiar character of its stratum; *L. purpurea* agrees more nearly than the others. The measurements are alike, the joints show no constriction. The violet color, however, which in the last species appears to be constant, is peculiar to a certain stage only of *L. nana*. The habit and habitat, likewise, distinctly separate the two.

Chætophora calcarea Tilden, Am. Alg. Cent. I. no. 11. 1894 (*pl. VIII.* and *pl. IX., figs. 6–7*)—Thalli globose, subglobose, or confluent into ridges, encrusted with lime. Lower cells 9μ in diameter, 3–5 times as long; upper cells 8–12.5μ in diameter, two times as long; articulations distinctly contracted at joints; terminal cells usually rather blunt, sometimes ending in very long articulated setæ.

The presence of lime in the thallus has been employed as a varietal character in the genus Chætophora in two instances, viz.: *Chætophora cornu-damæ* (Roth) Ag. var. *crystallophora* Kg. and var. *incrustans* Rabenh. An examination of herbarium material comprised under eight species indicates the presence of lime in quantity in twenty-seven out of forty-five cases. Eighteen specimens show no trace of the substance. Out of twenty specimens of *C. cornu-damæ*, ten showed strong indications of lime, four of these being of the var. *crystallophora*, and two being of the var. *clavata*. Eight out of the nine specimens of *C. tuberculosa* were encrusted with lime.

Kjellman's specimen from the polar sea, *C. pellicula*, said to form a crust 200–300μ in thickness, is in all probability a lime secreting plant.

C. calcarea and a plant nearly related to this genus, *Stigeoclonium flagelliferum* Kg. (*Pilinia diluta* Wood), both studied in this laboratory, possess the capacity of secreting lime to a remarkable degree. In both the calcium carbonate is deposited in the form of crystal plates, which are penetrated by the filaments and branches of the plant.

Taking these facts into account, it would seem that the presence or absence of lime in Chætophora thalli should be regarded as a factor in the determination of the species.

CHANTRANSIA PYGMÆA (Kg.) Sirodot, Les Batrachospermes 244, 245. 1884. Am. Alg. Cent. II. no. 112. 1896 (*pl. IX., fig. 8*)—Stratum very thin, when dry forming a violet-colored calcareous crust on lower shaded surface of dead twigs. Filaments straight; branches erect, sometimes appressed to stem, apices somewhat attenuate; articulations 11–12μ in diameter, in general 2–3 times the diameter in length; branches bearing sporules short, situated in upper portion of the plant; sporules in general 2–3 upon a branch.

The description of the asexual form of *Batrachospermum crouanianum*, as given by Sirodot, seems to cover fairly well the characters of the above plant. But, so far as is known, the capacity for secreting lime has not hitherto been noted in connection with this species.

A still more curious alga is one which inhabits the white sandstone cliffs at a point where Minnehaha creek flows into the Mississippi river. The rock presents no trace of plant life on its outer face, which has the usual appearance and light gray color of weathered white sandstone. But small pieces broken off and held up to the light show fine colorless threads hanging from the inner side of the fragments. These are filaments of a Schizothrix. The plant is found at least one-half inch from the outer surface. The amount of light received by it is necessarily extremely small, for the reflecting surfaces offered by the crystals are very numerous in such a thickness of stratum.

There is some difficulty in extracting the algal threads from the sand grains. The only satisfactory method is to moisten a bit of the material and place it under the low power of the microscope. The grains can then be removed with a needle, allowing the filaments to remain. It is necessary to use a $\frac{1}{16}$ oil immersion lens in order to observe the dissepiments.

Schizothrix rupicola Tilden, Am. Alg. Cent. II. no. 175. 1896 (*pl. IX., fig. 9*)—No definite stratum. Filaments 9.6–16μ in diameter; sheath cylindrical, rough, for the most part hyaline, sometimes brownish and much lamellated; trichomes pale æruginous, one to many in a sheath, not constricted at joints, 3.5–4.8μ in diameter; articulations 1–1.5 times as long as wide, 5–8μ long; dissepiments for the most part invisible; apical cell truncate conical or rarely somewhat attenuate.

Bare and dry sandstone cliffs, not on surface of rock, but extending within the interior to a distance of at least 10–15^{mm}. Collected by Professor C. W. Hall, Sept. 28, 1896.

S. rupicola agrees with *S. Friesii* in the diameter and length of the articulations and in the shape of the apical cell; but the trichomes do not display the constriction at the dissepiments which is so evident in the latter species, nor are the dissepiments themselves so conspicuous, it being nearly impossible to observe them even under the $\frac{1}{16}$ oil immersion lens. Furthermore, it does not possess a coarsely granulate protoplasm, which characteristic Gomont proposes as a test for recognizing the species. It also differs in habitat. *S. rubella* is likewise similar in the matter of dimensions and in the non-constriction of the joints. It disagrees, however, in having distinct

dissepiments, coarsely granulate protoplasm, and forming a reddish lime incrusted stratum on wet rocks. In the morphological characters of the filament, *S. rupicola* approaches *S. penicillata*, but is distinguished from it by the entirely different habit.

The plants described in this paper as inhabiting the limestone crust were collected and studied at intervals during a period of two years. I wish to thank Professor MacMillan for the help he has given me in the work.

BOTANICAL LABORATORY,
UNIVERSITY OF MINNESOTA.

EXPLANATION OF PLATES VII–IX.

PLATE VII.

Photograph of deposit on one of the planks from the southwest side of the tank. The crust is made up of the Dichothrix and the two Lyngbyas.

PLATE VIII.

Photograph of deposit on a plank from another side of the tank showing Chætophora thalli.

PLATE IX.

FIG. 1. Filament and pseudobranch of *Dichothrix calcarea*.

FIG. 2. Young filament of the same.

FIG. 3. Group of branches of the same.

FIG. 4. Group of filaments of *Lyngbya martensiana calcarea*.

FIG. 5. Group of filaments of *Lyngbya nana*.

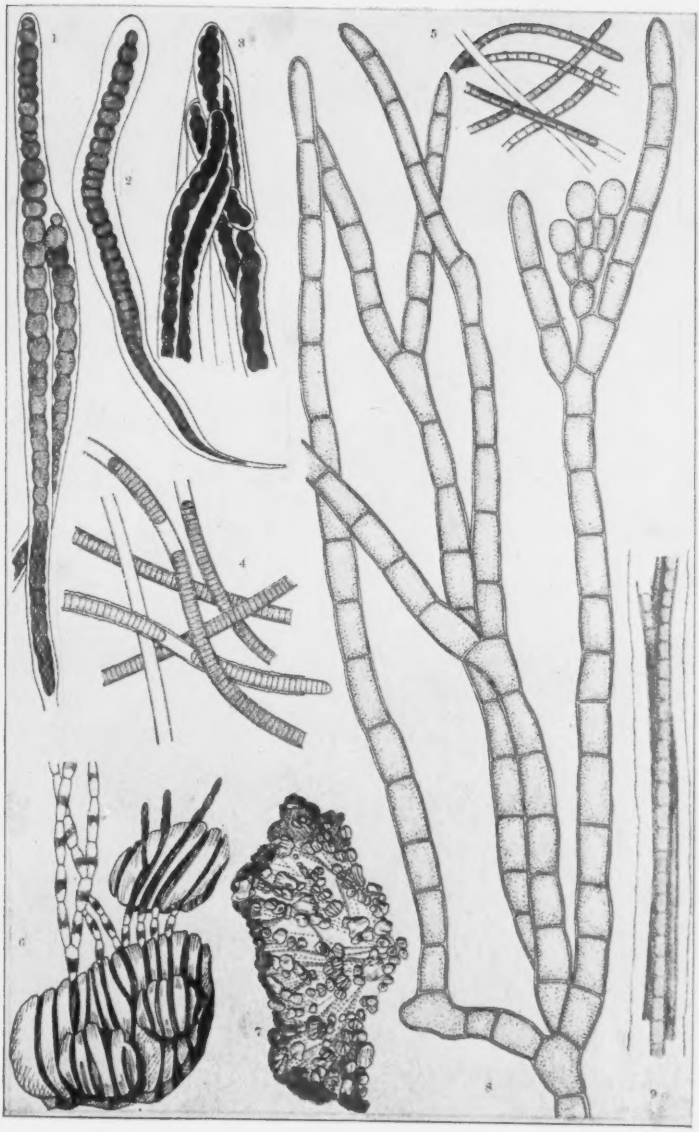
FIG. 6. Filaments of *Chætophora calcarea* penetrating crystal plates.

FIG. 7. Section through thallus of *Chætophora calcarea* showing arrangement of crystal plates.

FIG. 8. Portion of a plant of *Chantransia pygmæa* showing branch bearing sporules.

FIG. 9. *Schizothrix rupicola*, with sheath containing three filaments.

TILDEN on LIME ALGÆ.



TILDEN on LIME ALGÆ.

NOTES ON UROGLENA AMERICANA Calk.

G. T. Moore, Jr.

(WITH PLATE X)

In November 1895, at the suggestion of Dr. Farlow, I obtained specimens of the peculiar organism described by Calkins (1) as *Uroglena Americana*, and attempted to make some observations concerning it. The genus Uroglena, established by Ehrenberg (2) in 1833, referred to by Bütschli (3) and Stein (4), and considered at some length by Kent (5), has been observed in the public water supplies of Massachusetts and Connecticut with more or less regularity since 1889. In addition to the original species, Calkins (6) has found two others which he describes as *U. radiata* and *U. Americana*. Thus far I have been able to examine only *U. Americana*, and the following observations have been made upon that species.

While neither *U. volvox* nor *U. radiata* have been reported as causing any perceptible change in the water, *U. Americana* produces a very disagreeable odor, and a decided fishy oily taste. In the pond at Norwood, Mass., where all the material was obtained, the water was almost unfit for use, and caused great inconvenience. Calkins (7) seems to have successfully shown that this peculiarity of the species is due to the presence of numerous oil globules in the individual cells, and that contamination takes place through the liberation of this oil rather than from decay. The individual cells, as well as the colonies, are extremely delicate and the slightest disturbance is apt to break them up. While the water in the pond at Norwood was not noticeably disagreeable, the process of pumping it through several miles of pipe into a reservoir was sufficient to completely disintegrate the cells, and thus the reservoir water became polluted through the mechanical breaking of the colonies and cells, and consequent liberation of the oil.

THE CŒNOBIUM.

The colony of *U. Americana* presents a somewhat similar appearance to that of *Volvox globator* L. That is, it consists of a more or less spherical sac of transparent jelly, in the periphery of which are numerous green cells provided with cilia which cause the organism to rotate slowly through the water. There the resemblance ceases, and in no way can the two be said to have a generic relation.

In size and shape the Uroglena cœnobium varies greatly. While the general outline may be spherical, it is frequently found with protuberances and irregularities. All stages, from that of a perfect globe to a long cylinder with closed ends, have been observed, and many modifications of these extreme forms are apt to occur. The size varies as much as the shape. From the first early stages, consisting of but a few cells and measuring 30–40μ in diameter, we may have all gradations up to the somewhat unusual size of 525μ containing hundreds of individual cells. In the latter case the colony had been kept for some time under most favorable conditions, and probably represents the maximum growth.

The individual cells are irregularly placed, and from 10–20μ apart. There are no connecting canals as in Volvox. In regard to the structure of the interior of the colony of the original species (*U. volvox* Ehren.) there has been quite a difference of opinion. Ehrenberg (6) held that the contents were fluid, and the individual cells were drawn out into "tails," all these "tails" being united at a common point in the center of the cœnobium. Neither Stein nor Bütschli observed anything of this kind, and considered it very improbable, Stein even maintaining that the colony was a homogeneous mass of jelly from center to circumference. Kent (5) confirmed the observations of Ehrenberg in regard to the appendage of the individual cells, and suggested that they might be contractile. Zacharias (7), in a recent article, brings forward the view that *Uroglena volvox* does possess an internal network of threads or "tubes," but he further maintains that the prolongation from each individual cell is not in direct

communication with the center of the colony. Instead, he finds that the interior of the cœnobium is filled with a system of dichotomously branched threads, which radiate in all directions from a common center, and near the periphery unite as a single filament with the base of the individual cell.

Coming to the condition of things in *U. Americana*, there can be no doubt that such an arrangement of threads does not exist. In fact, no prolongation of the individual cell is found in any form. Careful staining with alum hæmatoxylin (the method used by Zacharias) failed to reveal the slightest trace of any connection of the cells with the interior of the colony, and various other methods were tried with the same negative result. In addition to the test of the stains, the manner in which the colony breaks up would indicate that there is no "central binding structure," for *U. Americana* is characterized by the extreme delicacy of its colonies, and while other species will stand a reasonable amount of manipulation, this form begins to separate upon the slightest change of condition, and certainly does not assume the definite arrangement of *U. radiata*, for example. Finally, the fact that numerous protozoa swim here and there in the cœnobium without obstruction, and colonies half the size of the enclosing one are found revolving freely within, would seem to show conclusively that no network of threads, as described by Zacharias in *U. volvox*, could exist in this species.

THE INDIVIDUAL CELL.

The individual cells, which are placed in the periphery of the jelly like globe, vary slightly in size, ranging from 7–11μ in diameter. The great majority are spherical, but occasionally the end towards the center of the colony will be slightly tapering. In no case, however, do they approach the long drawn out appearance of those cells figured by Ehrenberg and Zacharias, and *U. Americana* is most definitely defined by the spherical outline of its individual cells.

Each cell is provided with two cilia of unequal length, the longer sometimes reaching 20μ, the shorter seldom more than

4μ. At the base of the cilia is found an elliptical or oblong red spot, and a well defined nucleus is located near the center of the cell. One or two vacuoles of a non-contractile character are present, and numerous oil globules distribute themselves throughout the individual. There is but one chromatophore, which is yellowish green in color. This usually clings close to one side of the cell, or may occupy the end towards the circumference of the colony. The base of the cell is sometimes filled with oil globules, but is generally hyaline. Previous to the observations of Zacharias two chromatophores were reported as being present, but he demonstrated the fact that while in *U. volvox* the chromatophore frequently assumed a spiral arrangement, which made it appear divided, there was in reality never but the one color body. In *U. Americana* there is no spiral arrangement noted, and little or no difficulty is experienced in making out the single chromatophore. When the cells are ready to divide, however, there are two chromatophores present, and this may have caused the error in former observations.

The division of the individual cell takes place in the following manner. A single cell begins to turn so that the cilia are in a plane with the tangent of the sphere, instead of at right angles. The chromatophore divides and occupies opposite sides of the cell and a new red spot makes its appearance somewhat away from the old one, but not necessarily in the place where the new cilia are to originate. At the point directly opposite that at which the old cilia are located a new pair of cilia are formed, and we then have a somewhat larger cell with two chromatophores, two red spots, and two sets of cilia at opposite sides. All of this takes place before the cell begins to elongate or divide in any perceptible manner. After the new pair of cilia is completed the cell begins to lengthen in the direction of its cilia, and in a short time an oblong cell, nearly three times as long as wide, with a pair of cilia at each end, is formed. It is now that actual division begins to take place, and it only requires a few minutes to complete the operation. Halfway between the two pairs of cilia a constriction appears, and while

it extends entirely around the cell the depression is always deepest at the side nearest the periphery of the colony. Thus the pressure is greatest from that side, and consequently the halves of the dividing cell are gradually turned at right angles to their former position, and at the time when complete division takes place present their normal appearance, viz., with cilia at right angles to the tangent of the cœnobium. The red spot, which may have been in almost any part of the cell at first, takes its place at the base of the cilia before the final separation occurs. A reference to the figures will explain better than any description just how this division takes place.

THE RESTING STAGE.

Under certain conditions it is possible for an individual cell to lose its cilia and, forming a thick gelatinous wall, go into a resting stage. When this occurs the chromatophore breaks up and the chlorophyll is distributed throughout the entire cell, the red spot wholly disappearing. After a time the contents of this encysted cell divides and forms two elliptical bodies, and these in turn dividing we have four elliptical cells within the original cyst wall. Each daughter cell is provided with a red spot and a pair of cilia before the wall is ruptured, and so is ready to begin the process of division and formation of a new cœnobium as soon as liberated.

When the cells are first set free the chromatophore does not occupy the definite position that it does later, but is distributed equally throughout the contents of the cell, and is of a brighter green color. Oil globules are very abundant at this time, and give the cells a decided granular appearance. In a very few instances a cyst was observed that had divided into eight daughter cells. This was mentioned by Kent (5), but does not seem to be the general rule, and certainly is not necessary.

TAXONOMIC POSITION.

From the large number of colonies examined, and the length of time the observations covered, it would seem probable that

enough negative evidence had been secured to justify our considering Uroglena as being among those forms which have no sexual mode of reproduction. It is certain that up to the present time nothing has been observed that can in any way be considered as indicating anything but the simplest methods of multiplication. Kent (5) observed bodies which he designated as "microspores" and "macrospores," but that is the most that can be said in regard to the fact. Zacharias (7) calls attention to larger cells in the periphery of the cœnobium, containing two red spots and two chromatophores, which he names "zygote formers." Since he does not describe the process of conjugation, one is led to believe that it had not been observed and, for the present at least, the term zygospore will have to be classed with the microspores and macrospores of Kent. It naturally occurs to one that the so called zygote forming cells of Zacharias were merely ordinary individual cells about ready to begin the process of division.

It would seem, then, since the only known method of reproduction is by simple division, that the taxonomic position of Uroglena, if it is to be regarded as a plant, must be among the multicellular Chrysomonadaceæ of the class Syngeneticæ.

It is so placed by Warming (8), and more recently by E. Lemmermann (9), and while the characters of the genus are hardly in accord with the family Syngeneticæ as defined by Rostafinski, still it would seem that under the generally accepted idea of the Chrysomonadaceæ Uroglena would find a place in that order, together with Syncrypta.

From the foregoing account it will be seen that *U. Americana* varies decidedly from the description of *U. volvox* as given by Ehrenberg, Zacharias, and others. The fact that the European species is found most abundantly during the summer, while here the colder months are more favorable to its growth, may account for some of the minor variations. It seems probable, however, that what has been considered *U. volvox* by previous observers has not always been the same species, and that much of the inability to agree, and the surprise expressed by more recent writers that certain structures had not been seen by former investigators,

is due to this fact. According to Zacharias the cilia of *U. volvox* are more nearly of the same length, there are no vacuoles or oil globules, and the individual cells are elliptical or oblong, being invariably drawn out into a tapering point which is prolonged into a thread. On the other hand, *U. Americana*, as shown, contains no network of threads, and the individual cells are spherical in outline, not being prolonged in any way. The single chromatophore seems to be common to both species. The method of reproduction in *U. volvox* has not been satisfactorily demonstrated and no comparison can be made; however, nothing has been observed thus far, that would make it improbable that the peculiar method of multiplication as described above for *U. Americana* does not exist in the original species.

For convenience I append a somewhat modified description of this species as given by Calkins:

UROGLENA AMERICANA Calkins, 23d Ann. Rep. Mass. State Board of Health, 1891.—*Cœnobium:* irregularly spherical, varying greatly in shape and size, averaging 200–300 μ; no peripheral canals or internal network of threads; revolves slowly through the water by means of cilia of individual cells. *Individual cells:* spherical or occasionally slightly elliptical, never prolonged into an appendage at end towards center of colony; two cilia of unequal length, 15–20 μ and 2–4 μ respectively, the longer with decided undulatory motion; red spot at base of cilia and a single chromatophore, of a yellowish green color, usually occupying one side of the cell and clinging close to the wall; nucleus, non-contractile vacuoles, and numerous oil globules present.

Water supplies of Massachusetts and Connecticut. September-June.[1]

I desire to acknowledge my indebtedness to Professor Farlow for his interest and advice, also for the loan of valuable and necessary literature on the subject.

CAMBRIDGE, MASS.

[1] Since the above went to press, Uroglena has been reported from Indiana by Mr. S. Burrage of Purdue University, and probably will be found to be widely distributed.

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EXPLANATION OF PLATE X.

Uroglena Americana Calk.

FIG. 1. General appearance of colony, × 333.

FIG. 2. Individual cell, × 2000.

FIG. 3. Individual cell with two chromatophores, two red spots and two sets of cilia, ready to elongate, × 2000.

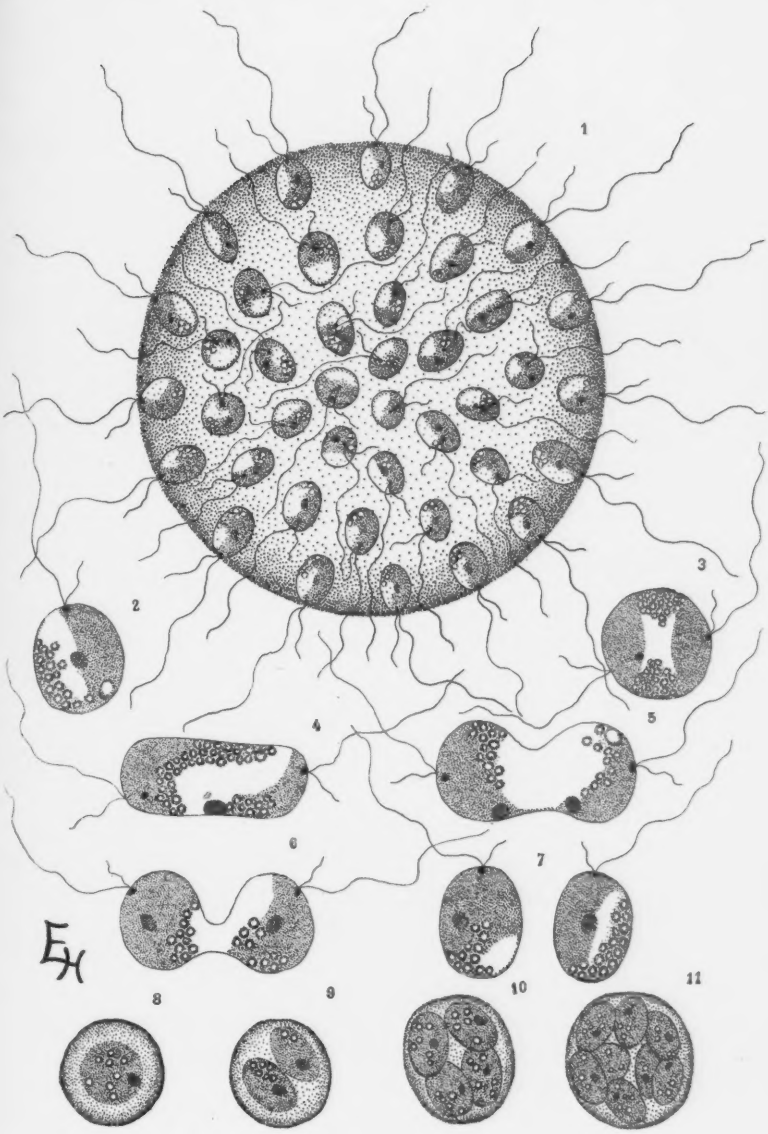
FIGS. 4–7. Successive stages in the division, showing manner in which cell turns from horizontal to vertical position, × 2000.

FIGS. 8–11. Encysted forms, × 1000.

FIG. 8. Before division.

FIGS. 9–11. Various stages in formation of daughter cells.

All drawn from nature, and as far as possible sketched with an Abbé camera.



MOORE on UROGLENA.

HYPOXIS ERECTA Linn.

A BIBLIOGRAPHICAL STUDY.

Theo. Holm.

(with plate xi)

Some of the numerous synonyms which have arisen from the first to the second edition of Linnæus' *Species plantarum*, and which have become a necessity to the systematic botanist to understand and recognize, appear at first glance to be rather surprising, and are well worth submitting to a closer investigation. The transferring of a generic name from one genus to another is not uncommon in the Linnean publications, but there seems to have been, at least in some cases, a good reason, if not excuse, for making a change of this kind. From a bibliographical point of view, it is often quite interesting and instructive to investigate some of these changes, and the writer has had in the present case a certain inducement for trying to discover the reason which led Linnæus to describe our amaryllidaceous genus Hypoxis at first as an Ornithogalum.

No critical or conscientious botanist should accuse Linnæus, however, of having overlooked so important a character as the position of the ovary, which is superior in Ornithogalum and inferior in Hypoxis. Linnæus was too well acquainted with such primary characters, and it was due, therefore, not so much to his own defective observation as to the misleading descriptions of previous authors, whose works were the only ones accessible to Linnæus at the time when he wrote his first edition of the *Species plantarum*. It is absolutely necessary, therefore, to admit a distinction between Linnean synonyms and *nomina nuda*, when a Linnean change of name is to be verified. The fact is that the name *Ornithogalum hirsutum*, which appears in the first edition of *Species plantarum* (p. 306), was rejected by Linnæus himself

in the second edition of the same work, and simply used as a quotation for what he had thought to be a well distinguished species of Ornithogalum, instead of being a combination of two different genera. It is beyond any doubt, therefore, that Linnæus really once intended the name *Ornithogalum hirsutum* for our *Hypoxis erecta*, but his knowledge of this plant was largely, if not exclusively, based upon defective descriptions and illustrations given by earlier authors.

In order to present the Linnean quotations as complete as possible, I have thought it best to reprint here the diagnoses of the first three species of Ornithogalum, especially as the first edition of *Species plantarum* has become a very rare book. The Linnean diagnoses read as follows:

Ornithogalum.

luteum 1. *Ornithogalum* scapo anguloso diphyllo, pedunculis umbellatis simplicibus. Fl. suec. 270.
Ornithogalum scapo diphyllo, pedunculis simplicibus terminalibus, filamentis omnibus subulatis. Hort. Cliff. 124. Roy. lugdb. 31.
Ornithogalum luteum. Bauh. pin. 71.
Pyrrhochiton Reneal. spec. 91. t. 90.
Habitat in Europæ cultis macellis.

minimum 2. *Ornithogalum* scapo angulato diphyllo, pedunculis umbellatis ramosis. Fl. suec. 271.
Ornithogalum luteum minus. Bauh. pin. 71.
Hypoxis Reneal. spec. 92.
Habitat in Europæ cultis oleraceis.

hirsutum 3. *Ornithogalum* scapo angulato, pedunculis umbellatis villosis.
Ornithogalum scapo bifloro. Roy. lugdb. 31.
Ornithogalum virginianum luteum. Pet. gaz. I. t. I. f. 3.
Ornithogalum luteum parvum virginianum, foliis gramineis hirsutis. Pluk. alm. 272. t. 350. f. 12.
Ornithogalum vernum luteum, foliis angustis hirsutis. Gron. Virg. 37.
Habitat in Virginia, Canada.
Spec. 1. 2. 3. maxime affines sunt.

This last remark certainly indicates that Linnæus did not suspect *Ornithogalum hirsutum* to be generically distinct from the two other plants. His knowledge of the American plant must have been very imperfect at that time, and the descriptions given

by previous authors do not differ in any respect so as to leave a doubt concerning the true relationship of our plant. They all agree in naming it Ornithogalum, even Gronovius, who undoubtedly was in possession of specimens from Clayton, who had collected the plant in Virginia.

If we compare the various quotations given above by Linnæus, we will obtain a good idea as to how much knowledge the old authors possessed of the genus Ornithogalum. The two species enumerated by Linnæus as nos. 1 and 2 were transferred later by Salisbury to his new genus Gagea (p. 553),[1] since these showed a very marked difference from the true species of Ornithogalum. We even notice that Reneaulme (pp. 91 and 92) did not consider these two species as belonging to Ornithogalum, since he gave them the generic names Pyrrhochiton and Hypoxis, the first of these containing *O. luteum*, the second *O. minimum*. The quotation "Pet. gaz. I. t. I. *f. 3*" should have been *f. 11*, since *f. 3* represents a Chiton, and *f. 11* on the same plate represents our *Hypoxis erecta*. The description[2] reads as follows: "*Ornithogalum* Virginianum luteum, foliis gramineis hirsutis nobis." "Its hairy grasslike leaves distinguish it," and the plant is said to be "common in Carolina, Maryland and Virginia."

Petiver, from whom these quotations are taken, quotes again Ray, who evidently was the first author to publish a description of our Hypoxis as "*Ornithogalum* luteum parvum foliis gramineis hirsutis." This description (**2**: 1928) was not given, however, by Ray himself, but by Banister, who had sent a catalogue to Ray, wherein he enumerated and described such plants as he had observed in Virginia.

Another old citation is that of Plukenet (Alm. bot. mantissa, 272), who like Petiver figures the plant. Comparing these two figures with each other (*pl. XI*), it is evident that they were both intended to represent *Hypoxis erecta*, but the principal characters, inferior ovary and short stamens, have not been figured

[1] The references are to books enumerated under "Bibliography" at the end of this paper.

[2] PETIVER: Decas prima **1**: *pl. 1, fig. 11*.

correctly. Plukenet even figures a small calyx besides a 6-leaved corolla, and he has also indicated the presence of small bulblets at the base of the main bulb, as in Gagea, but which do not occur in Hypoxis. Plukenet, no doubt, made his figure from a poorly preserved specimen of Hypoxis, and he changed certain parts in order to make the drawing fit into the genus Ornithogalum. Plukenet's diagnosis in *Almagestum botanici mantissa* (p. 272) is given as follows:

"*Ornithogalum* Virginianum floribus luteis, atra macula insignitis, summo caule veluti in umbellam diffusis."

No "atra macula," however, is to be observed in the flowers of Hypoxis or Ornithogalum. We might note here, in order to give some idea of Plukenet's comprehension of Ornithogalum, that this author in his *Phytographia* (*pl. 102, fig. 3*) figures another species of Ornithogalum:

"*Ornithogalum* affinis Virginiano, flore purpureo pentapetaloide. Banist. Cat. Msc."

This, however, represents *Claytonia Virginica!* These two figures, given by Plukenet and Petiver, seem to have been the only ones which at that time were known to Linnæus, although a third was then in existence in Dillenius' *Horti Elthamensis plantarum*, Linnæus does not seem to have known this figure (*pl. 220*) until he published the second edition of *Species plantarum*, wherein he gives the full quotation from Dillenius: "*Ornithogalum* Virginici facie, herba tuberosa Carolinesis," a plant which Linnæus named *Hypoxis sessilis*."

This plant does not differ, however, from *H. erecta*, excepting that the flowers are situated close to the ground. It is to be noted that in this figure the details of the flower are very well shown, and there is no doubt that if Linnæus had seen this figure when he first wrote the *Species plantarum*, he would have been able to discover the mistakes in Plukenet's and Petiver's two figures, and he would perhaps at that time have referred our plant to Hypoxis instead of to Ornithogalum.

The remaining Linnean quotation is that of Royen (p. 31) which is too short and incomplete, however, to give any idea of

the genus Hypoxis. It is also very doubtful whether Royen really had this plant in cultivation in the botanical garden at Leyden as early as 1740, since it has been stated that Hypoxis was not cultivated in Europe until 1752, and, as far as can be ascertained, first in England. These four citations of the works by Plukenet, Petiver, Royen, and Gronovius constituted, therefore, the only literary sources to which Linnæus had access at the time of his writing the first edition of *Species plantarum*, at least so far as concerns *Ornithogalum hirsutum*. The two preceding species, *O. luteum* and *O. minimum*, were both well known to him, as he cites these from his own works (*Flora suecica* 96, and *Hortus Cliffortianus* 124). He also quotes Bauhin's *Ornithogalum luteum* and *O. luteum minus* as synonyms of his *O. luteum* and *O. minimum*, now known as *Gagea lutea* and *G. minima*. There is, therefore, some reason to believe that Linnæus had not seen Hypoxis, either in a living or dried state, and that his first specific diagnosis, so closely resembling those which he quotes, must have been merely transcribed from them with help from the illustrations before him, which did not indicate the inferior ovary and short stamens of Hypoxis. None of the descriptions with which he was acquainted differed in any essential respect from each other, or from the general understanding at that time of the genus Ornithogalum. The diagnosis in Gronovius (p. 37) was very likely the most influential with Linnæus, so far as the relationship of the plant was concerned.

The name Ornithogalum has an old history, and may be traced far back to the Greeks and Romans. Both Dioscorides (p. 541) and Plinius (**21**: chap. 62) mention an Ornithogalum with edible bulbs, but it is far from certain that their plant was identical with the genus which now bears that name. Among the earliest authors who unmistakably described not only Ornithogalum but also Gagea may be mentioned Fuchs, who has illustrated and described "Bulbus sylvestris" or "Oignon sauluaige" (p. 95); Lobelius (p. 72), who figures the same species of Gagea as *Ornithogalum luteum*, besides the true *O. umbellatum*, under the name "*O.* Leucanthemus minor," which is also described by

Dodonæus (p. 221) as "Bulbus Leucanthemus minor;" and Clusius (p. 188), who has described and figured *Gagea lutea* as "*O.* pallido flore," and another species of Gagea as "*O.* Pannonicum luteo flore." The Dillenian genus Stellaris (Cat. plant. 110) indicates the first distinction between the true species of Ornithogalum and those which Salisbury referred to his Gagea.

It appears, according to the above statements, that the European genus Ornithogalum, including Gagea, was very well distinguished before Linnæus undertook to write his *Genera* and *Species plantarum*. The rather superficial, but nevertheless quite striking, similarity between the small yellow-flowered species of Gagea (Ornithogalum of Linnæus) and the American Hypoxis made several authors from Ray to Gronovius confound these, so as to consider them all as belonging to Ornithogalum, until Linnæus himself was led to make the same mistake. Linnæus, however, corrected the mistake in the second edition of his *Species plantarum*, and his characterization of Hypoxis in *Systema vegetabilium*, "Hypoxis corolla supera," is sufficient to prove that he had obtained material finally for a correct description of the plant, inasmuch as he changed the formerly given specific name *hirsutum* to *erecta* (*Sp. pl.* 2d ed. 439). As a matter of fact, *Hypoxis erecta* is not "hirsute," but "pilose," as Linnæus later on described it. That he named it *erecta* was evidently to distinguish it from the related species *decumbens*, *sessilis*, *sobolifera*, etc., all of which are hairy; while the former specific name, *hirsutum*, would have distinguished it at once from the species of Ornithogalum, of which only a few are slightly pubescent. Furthermore, that Linnæus had not seen the plant in a living state, not even when he wrote the sixth edition of his *Genera plantarum* (1764), is evident from his marking the genus with a cross, which according to his preface means: *Crucem ubi siccas solum habere potui!* The plant Hypoxis, as stated above, was not cultivated in Europe until the year 1752, and very likely first in England. It seems, therefore, according to the preceding statements, that Linnæus had no direct knowledge of Hypoxis until he published his second edition of *Species planta-*

rum, and that his first treatment of the genus as an Ornithogalum was due to the defective diagnoses and illustrations given by his predecessors. The name *Ornithogalum hirsutum*, therefore, is a *nomen nudum*, and Linnæus should certainly not have been obliged to preserve the specific name *hirsutum* because he changed the generic. His own observation of the dried specimens, when he finally received these, showed him his mistake as to the genus and as to the character "hirsute," which is only too evident from his renewed characterization of the species as "pilose." It is evident, therefore, that *H. erecta* L. should not be set aside for *H. hirsuta* (L.) Coville.

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EXPLANATION OF PLATE XI.

FIG. 1. A photographic reproduction of Plukenet's figure of *Hypoxis erecta* L.

FIG. 2. A similar reproduction, but reduced one-half, from Petiver's illustration of the same plant.

1. 2.

HOLM on HYPOXIS.

BRIEFER ARTICLES.

ZIZIA AUREA AND THASPIUM AUREUM.

For the past two seasons special observations have been made upon these plants. Combined with those of previous years they furnish a fair outline of the habits and character of the two as they are found in those parts of Illinois and Indiana contiguous to Chicago. A large number of specimens were critically examined and compared and abundance of field notes made. Although the two plants have frequently been confounded by collectors, I find few plants so nearly allied that are better distinguished specifically, and a little practice enables one to tell them from the time the radical leaves attain a fair size in the spring.

The beginning and duration of the flowering season of the two plants differ, and still more those of the fruiting season. The ordinary season of anthesis of *Z. aurea* in this region is from the middle of May to the middle of June, while that of *T. aureum* is from the first of June up to near the middle of July, usually lasting two or three weeks longer than in the case of *Z. aurea*. The remarkably early spring of 1896, due to the summer heat of April, brought both plants forward considerably earlier, and the terminal umbel of the stem of *Z. aurea* was beginning to bloom by April 30. By the 12th of May the plants were in full flower. At the latter date all examples of *T. aureum* that were found were in bud. When next examined on the 23d of May they had come into flower, but the anthesis was principally confined to the first umbel. The fruit of *Z. aurea* begins to ripen during the first half of July, and by the last of August has about all fallen from the dead stems of the plant. I have found it clinging to the carpophore as late as September 7, but the connection was so fragile that the slightest disturbance dislodged it. The mericarps of *T. aureum* are well advanced by the first of August, and in an early season like the last some will be ripe by the last of the month, but the ordinary time of ripening is September, and nearly all of the carpels are found adher-

ing to the rays of the umbellets then. I have found the carpels still adhering to each other as late as October 19. While the two plants differ by about two weeks in beginning their anthesis, they differ from four to six weeks in the time needed to mature their fruit. The fruit of *T. aureum* not only matures more slowly, but also adheres more firmly to the carpophores, and requires a greater force to detach it.

This later ripening and firmer attachment of the fruit evidently has a bearing on the distribution of the plants. The Zizia is seen scattered about over wide spaces in localities where it grows, while the Thaspium is apt to occur in patches or colonies. The fruit of the former is readily torn off by any slight jar given by passing animals or by the wind, and is by these means often thrown quite a distance around. The fruit ripens and the stalks die before the appearance of frost. The fruit of the Thaspium usually falls to the ground with the ripened stalk, or this may be cut down by an early frost. Its firmer attachment tends to keep it nearer by when dislodged. The seed is from these circumstances left near the parent stock, and from its mode of distribution helps to keep the plants in patches. Owing to the longer life of the plant the fruit as well as the stem and leaves frequently become purple in late summer, and quite generally so late in the season at the time of frost.

There is quite a difference in the general appearance of the two plants. The leaves of *T. aureum* are of a lighter shade of green; their texture, even when thin, rather firmer than in *Z. aurea*, and the network with larger and more open meshes. They are bordered by a white hyaline line, which often becomes prominent, especially in the lower leaves. In *Z. aurea* the network is very fine, the meshes small, the hyaline line very narrow, the whiteness often limited to the tops of the serratures, which are sharp in most cases and callous tipped. Familiarity with this leaf structure enables one to tell the plants in nearly all stages of growth, as they are quite constant. The flowers of *Z. aurea* are golden yellow, as its specific name indicates; those of *T. aureum* are paler, inclined to a lemon-yellow. The rays in the umbels of the latter contract much more on their inner side than those of the former, so that they bend inward and bring the carpels more into a bunch, and make the diameter of the fruiting umbel considerably less than that of the umbel when in flower.

Two forms of *Z. aurea* may be noted: (*a*) A wood form, grow-

ing in the woods or shady places. It is commonly the taller of the two, from three to five feet high, the radical leaves on petioles twelve to twenty inches long, the leaflets large, the terminal 2–4 inches long by 1½–3 inches wide. The leaflets are very sharply, often doubly serrate, or somewhat serrate-lobed. (*b*) A prairie or meadow form. This is usually seen in fields or in the thinly wooded sections of the sand dune region. It is a smaller plant, from eighteen inches to three feet high, the radical leaves on petioles a foot or less in length. The leaves are tinged with yellow, generally simply serrate, or the lower stem and radical leaves serrate-crenate. The fruit is essentially the same in both forms, though the carpels in (*b*) are apt to be broader than deep, a cross section approaching a circular form less nearly than in (*a*). The plants resemble *Z. cordata* more than those of the woods form, but I have not found any with cordate leaves, nor detected *Z. cordata* in our local flora.

The examples of *T. aureum* which I have seen here do not conform either to the type or to the variety *trifoliatum*. Though inclining to the variety it would be quite futile to try to draw a line of separation. The radical leaves, whether round-cordate and entire, or divided, are crenate or crenate-serrate. The cauline leaves change gradually along the stem from the basal with crenate-serrate margins to those which are serrate, the uppermost frequently quite sharply serrate. Plants with the radical leaves simple and cordate are common, but grow promiscuously with those having the radical leaves trifoliate, or both forms of radical leaves spring from the same root. A suite of radical leaves in various stages of development from the cordate to the trifoliate, or even pinnate, can easily be collected. Some are two lobed, cleft or divided, others three lobed, cleft or divided, or variously changing into subpinnate or pinnate forms. Cordate leaves are rarely absent from a group of plants. If not attached to the stem-root, a little searching reveals them as the leaves of seedlings close at hand. These are generally entire, but some have the lobation commenced. Dividing is, however, infrequent until the root is old enough to bear a leafy stem.

Sometimes the ribs of *Z. aurea* are expanded so as to make a narrow wing, and it is hardly proper to call the fruit in all cases apterous. But other characters so plainly distinguish it from *T. aureum* that the two are readily separated specifically, even if they were to be united generically. Though the terminal fruit in the

umbellets of the two plants is frequently aborted, when present I have found no exception to its sessile character in Zizia and stalked in Thaspium.

As far as I have met with the two plants in this region they differ in their habitats. *Z. aurea* is very abundant, and occurs throughout in suitable localities, and grows indifferently in clayey and in sandy soils, but more vigorously in the former. *T. aureum* is infrequent, and has always been found in clayey or loamy land, and almost always along streams. I have but one specimen away from streams or the vicinity of water, from Forest Hill, in the south part of the city. Its principal home is along the bluff banks of streams, or beyond the bounds of the flood plain. From these banks, either contiguous to the stream or bordering the flood plain, it spreads a little into the adjacent woods. In such situations I have seen it by the Kankakee river, the Desplaines and some of its branches, the Calumet, and Thorn creek, one of its affluents, and it is likely to occur under similar conditions along other streams of the vicinity.— E. J. HILL, *Chicago*.

A NEW ISOETES FROM IDAHO.

Isoetes Underwoodi, n. sp.—Leaves 18–50, rather slender, 10–16^{cm} long, erect to recurved, semi-lunate or nearly helmet shaped in section, striate, with abundant stomata above; peripheral bast bundles generally all four present, but sometimes one or more lacking: macrosporangia dark brown: microsporangia olivaceous, elliptic to narrowly oblong, much pitted, 6–8^{mm} long, slightly covered by the narrow wings of the velum: ligule rather narrowly triangular: macrospores *bright white*, 0.33–0.45^{mm} thick, rough with low single or confluent tubercles: microspores 0.025–0.028^{mm} long, unsymmetrical, short spinulose on the edges.

Wet ground, borders of pools, Paradise creek, in and near Moscow, Idaho.

This plant is submerged during a greater part of the spring, but seems to reach perfection entirely out of water. The dry leaves look more or less round, but this is due to the sharp lateral edges becoming so involute as to present merely a narrow channel along the widest side. The air cavities are generally quite large and the walls thin. It differs much from the only other two species of this region, *I. Nuttallii* and *I. Bolanderi*. From the first it differs in its longer

and more numerous leaves, spotted velum, bright white instead of brownish macrospores, and amphibious nature. From *I. Nuttallii* it differs in its partial, not complete velum, its usually four bast bundles, smaller macrospores, and amphibious nature.

I take pleasure in dedicating the species to Professor L. M. Underwood, to whose admirable little work, "Our Native Ferns and their Allies," I owe many an hour of profit and delight.— L. F. HENDERSON, *Moscow, Idaho.*

EDITORIALS.

The Metric System in Botany

THE BOTANICAL EDITOR of the *American Naturalist* has done well in calling botanists to account for their persistent use of the old units of measurement. We take it for granted that argument is no longer necessary to establish the claim of the metric system. As Dr. Bessey says, the scientific bodies of the country have urged upon Congress the advisability of legislating upon the subject, and are loud in their denunciation of the crudities of the old system. Among these protesting scientific men botanists are prominently represented, and it seems somewhat inconsistent for them to continue to use such measurements as lines, inches, etc. Usage is more powerful than legislation in such a matter, and the change will be effected for botanists when their standard texts and leading journals rigidly adopt it, at least in all technical descriptions. In the *Synoptical Flora*, begun so long ago, uniformity seems to demand a continuation of the old units in all subsequent parts. In so new a publication as the *Illustrated Flora* it is a pity that the metric system was not introduced. In the forthcoming *Flora of North America* it certainly should be adopted. The journals, however, can change at any time. It has been the policy of the BOTANICAL GAZETTE to use the metric system in all technical descriptions, unless for some reason the author prefers the old units. We would now suggest that all American journals and serial publications unite in making the change, not in loose fashion, but as an avowed policy.

Tropical Laboratory Commission

IT IS somewhat remarkable that the tropical laboratory proposition should have met with so immediate and so wide a response. Mr. MacDougal's announcement of the commission within two months of the first suggestion is noteworthy, but less so than the composition of the commission. It might have been expected that this duty would find only some of our younger botanists ready, but with Dr. Farlow and Dr. Campbell as the additional American members,

the commission becomes most adequately representative of American botanists. The institutional and botanical distribution of the commissioners is most happy. Their judgment will be competent to include every facility sought for in tropical surroundings, and their report will be regarded as final both as to the location and the advantages of a tropical laboratory. The assured cooperation of British botanists through a commissioner, and through liberal offers of facilities in case the station is established in British possessions, insures for the laboratory an international character.

OPEN LETTERS.

MOUNTING PLANTS FOR USE IN POPULAR LECTURES.

To the Editors of the Botanical Gazette: In winter, at our State Agricultural College, some one of the botanical department is often required to instruct students who elect short courses in grasses, clovers, other forage crops, or weeds. In like manner these subjects are often presented at farmers' institutes and agricultural fairs. Bunches or bundles of these plants are too easily damaged by handling to be of much service. I have found the following scheme for exhibiting plants on such occasions eminently satisfactory.

Procure some wire screen thirty inches wide and five or six feet long, having about four wires to the inch; fasten on one side numerous stout strips of wood an inch or more in thickness. Make a mate to this and we have a press of heroic size. With large driers and thin sheets grasses and other plants are pressed at full length. Procure some rather firm and tough manilla paper two feet wide and perhaps three feet long. For longer plants a sheet can be spliced by pasting a piece of the paper across a seam on the back. These manilla sheets of suitable length are then bound with brown or black muslin or other material neatly pasted over the edges and ends. This makes the sheets stiffer and protects the edges in transportation. The specimens are placed in suitable position and sewed fast with carpet thread of a dull green color, and where the leaves are broad fish glue is also used. Over the long stitches on the back side paper is pasted, *a la* buttons in a dry goods store, to prevent the plants from working loose in case a thread is broken.

Sew or paste on a large card containing name of plant and a few other items of importance. Two of Dennison's No. 12 spring hooks clasp the top of a sheet and hold it to a cord or thin strip of wood strung about a hall at suitable height.

To transport specimens a crate or frame is made consisting of sides only of half-inch basswood or pine nailed to three crosspieces, one by two and one-half inches. Near the end of each strip is a wire staple clinched on the side next the specimens. These staples serve to hold three strong straps to buckle about a bundle. To protect from accidental rain wrap the bundle of specimens with oilcloth before binding in the crate.

A large herbarium case is constructed, into which these long sheets are shoved sideways, each sheet having a name on each edge. Of these sheets we have at least 250 species mounted.—W. J. BEAL, *Agricultural College, Mich.*

THE TROPICAL LABORATORY COMMISSION.

To the Editors of the Botanical Gazette:—The organization of the commission for the selection of a site for a botanical laboratory in the American tropics is now complete so far as the American membership is concerned, with the following representation:

DOUGLAS H. CAMPBELL, Professor of Botany in Leland Stanford University.

JOHN M. COULTER, Head Professor of Botany in The University of Chicago.

W. G. FARLOW, Professor of Cryptogamic Botany in Harvard University.

D. T. MACDOUGAL, Assistant Professor of Botany, in charge of Plant Physiology, in the University of Minnesota.

As may be seen from the above list, the commission represents the entire country geographically, as well as the more important aspects of the subject. The British members of the commission will be announced in the GAZETTE for March.—D. T. MACDOUGAL, *University of Minnesota.*

CURRENT LITERATURE.

BOOK REVIEWS.

A primary reader.

THE revolution which the teaching of reading has undergone in late years demands books which shall not only provide exercise for the vocal cords, but also interest the pupil and command his attention. For this reason, instead of reading selections from the great orators, poets, and dramatists before the child can possibly understand or appreciate the subject matter, classics for children form the readers of the present day. Along with the nature study there has also arisen a demand for books relating to nature which can be read in school. Various efforts have been made to supply readers containing botanical matter. We have in these pages particularly commended the two books of selections by Miss Newell, which are admirably adapted to pupils in the grammar grades. We have before us a book which is intended for the primary grades. It is *Plants and their children*, by Mrs. William Starr Dana.[1]

It is not often that the intentions of an author so happily coincide with the execution as in this book. It is written in a style that cannot but be attractive to children of the age addressed. They are introduced first to fruits and seeds, then to young plants, and later to buds, leaves, and flowers, in a series of short chapters. The matter is not only attractively presented, but, happily, it is accurate as to its facts, with very few exceptions. One error, which is a mere accident, and which every child will be able to correct, is the ascription of tendrils to the bean (p. 115). Some others occur in the physiological parts, where also there are some figures of speech which are apt to lead to misconception, as, for example, saying that roots suck in water "by means of tiny mouths" (p. 100), and that what this "broth" "really wants is *cooking*" (p. 144). Naturally, when Mrs. Dana attempts to set before her young readers the difference between plants and animals she is tempted into considering only the green plants and gives them a test which will make all fungi animals. Regarding the dodder and the mistletoe our author also leads her readers somewhat astray.

But aside from these and a few similar blemishes (which can readily be corrected in the plates) the book is the freest from error of any book of the

[1] DANA, MRS. WILLIAM STARR. — Plants and their children. Illustrated by Alice Josephine Smith. 12mo. pp. 272. figs. 277. American Book Co. 1896. 65 cents.

kind that we have seen, and the author is to be heartily congratulated on the success of her work. The book is to be begun at the opening of the school year, and the lessons are so arranged as to discuss those objects which are accessible at the time when the lessons are intended to be read. The teacher is expected to have the objects themselves in the room, and if possible to have them collected by the children. We shall be much mistaken if an illustrated course of reading like this does not awaken in many a youngster a new interest in plants.

The illustrations are well drawn, and add much to the value of the book. A goodly number seem to be original; a few are from Kerner, which are acknowledged; while the majority are after the well known drawings of Sprague, in Gray's text-books, and might well have been acknowledged. The illustrator has drawn the English *Viscum* instead of the American *Phoradendron*, which is the mistletoe "sold in our shops at Christmas" over the greater part of the country, though possibly the English mistletoe comes to the New York markets. *Fig. 136*, alleged to be "a seed cut across," is like nothing in the heaven above or the earth beneath, and ought to be replaced.

Besides being suitable for schools this is the kind of book for which many parents are looking to put into the hands of their children, or to read with them in the home. Botanists are often asked to recommend such books, and there is now one which can be named to inquirers without misgivings.— C. R. B.

The nucleus.

THE recent extensive studies upon the cell nucleus have produced a voluminous literature regarding it. About three years ago a general and very brief summary of this literature was published by Dr. A. Zimmermann.[2] The same author has now brought together this and more recent scattered information, with critical sifting, to form a work upon the morphology and physiology of the cell nucleus.[3] In the general part he thus discusses methods of research, nomenclature, distribution, number, size, and form of the nucleus, its chemical composition, the structure of the resting nucleus, division, fusion, and physiology. In the special part the present state of knowledge regarding the nuclear phenomena of each of the larger groups of plants is given, with especial reference to reproductive processes.

How voluminious is the literature thus critically examined is probably not appreciated except by those who have given special study to cytology. The main phenomena regarding the nucleus are much alike in plants and ani-

[2] Beihefte zum Bot. Cent. 3:206, 320, 401. 1894.—4:81. 1895.

[3] ZIMMERMANN, A.— Morphologie und physiologie des pflanzlichen Zellkernes. Ein kritische Literaturstudie. 8vo, pp. viii + 188. figs. 84. Jena: Gustav Fischer. 1896. *M* 5.

mals, and Zimmerman has confined himself to pointing out the relations between the zoological and botanical researches. Though he therefore does not cite any very large number of the zoological papers, the list in the bibliography embraces almost 600 titles!

We are glad to observe that due notice has been given to the papers by American botanists, among whom may be noted Campbell, Humphrey, Davis, Chamberlain, Schaffner, Harper, Fairchild, Halsted, and Mottier.

This book will be needed in every library, and will be of great assistance to every teacher. It is well illustrated from drawings made chiefly by the author's wife.—C. R. B.

MINOR NOTICES.

MR. JAMES M. MACOUN has recently distributed three contributions to the knowledge of the Canadian flora.[4] The first two cited contain additions to the Canadian flora, additional stations, and the revision of names in accordance with recent monographs. The Labrador list is compiled from all available lists and specimens, being tabulated so as to show the distribution of each species.—J. M. C.

A SECOND CONTRIBUTION[5] to the flora of Yucatan has been issued from the Field Columbian Museum. It includes plants collected by Dr. G. F. Gaumer in 1895, Sr. Porfirio Valdez in 1896, and the author in 1887 and 1895. The contribution adds 120 genera and 272 species to the recorded flora of the peninsula, among which are a new genus (*Setariopsis* Scribner, founded upon *Setaria auriculata* Fourn. and *S. latiglumis* Vasey), and thirteen new species (Agaricus, Asterina, Pestalozzia, Selaginella, Peperomia, Cracca, Argithamnia, Croton, Euphorbia, Pedilanthus, Quararibea, Corallocarpus). So far as recorded 527 species are known from the mainland, and 315 from the contiguous islands. It is interesting to note that Leguminosæ head the list with 100 species, Compositæ following with seventy, Euphorbiaceæ with fifty-two, the remaining families dropping below thirty.—J. M. C.

MR. E. B. ULINE has just published an account of the Mexican and Central American species of *Dioscorea*,[6] being the result of studies at the University of Berlin. Thirty-nine species are included, eleven of which are

[4] MACOUN, JAMES M.—Contr. Herb. Geol. Sur. Can. VIII and IX. Reprint from Can. Rec. Sci. Oct. 1895, Jan. and Apr. 1896. List of the plants known to occur on the coast and in the interior of the Labrador peninsula. Ann. Rep. Geol. Sur. Can. **8**: 353–356.

[5] MILLSPAUGH, CHARLES FREDERICK.—Contribution II to the coastal and plain flora of Yucatan. Field Columb. Mus. Bot. Ser. **1**: 277–340. *pl. 8–21*. D. 1896.

[6] ULINE, EDWIN B.—Dioscoreae mexicanae et centrali-americanae. Engler's bot. Jahrb. **22**: 421–432. 1896.

new. Five new varieties also are defined and various specific reductions indicated. It would seem that the genus was sadly in need of revision, as are probably most of the Mexican and Central American genera.—J. M. C.

MR. GEORGE MASSEE has done excellent service to mycology in his redescriptions of Berkeley's types of fungi.[7] Berkeley's magnificent collection was presented to Kew in 1879, and illustrates his mycological publications from 1836 to 1885, containing over 11,000 species, among which are 4866 types. The earlier diagnoses were brief and superficial, and not at all adequate for the present demands. Mr. Massee has drawn up full descriptions, with figures, of Berkeley's types, using in every case the actual specimens originally employed by the author. About 115 species are thus described, over eighty of which belong to the genus *Peziza*.—J. M. C.

IN 1886 Professor Charles R. Barnes published a key to the genera of mosses recognized in the Manual of Lesquereux and James, which proved to meet a want of the bryologists. In 1890 he published keys to the species of mosses recognized in the same work, including descriptions of those published since the issue of the manual. Taxonomic work among North American mosses since 1890 has been so very active that a new presentation of North American material seemed justified. Accordingly a third edition of the "Analytic Keys"[8] has just appeared, which is intended also to stimulate the study of mosses during the time which must precede the publication of the new manual. The appendix to the Keys contains descriptions of species and varieties, 603 in number, published since the issue of Lesquereux and James' Manual in 1884, and before January 1, 1896. It is only upon the massing of these descriptions that one begins to appreciate the recent rapid development of our knowledge of the North American moss flora. The author feels compelled to call special attention to the large number of new species described by Dr. N. C. Kindberg, and by Dr. C. Müller in collaboration with Kindberg, from the Canadian collections of Mr. John Macoun, stating that there is good reason to believe that a majority of these are not well founded. In this view he seems to be sustained by other bryologists, and it is certainly unfortunate that such a mass of names has been injected into our synonymy, names which in many cases it is impossible to identify. Such a large amount of new material has necessitated extensive readjustment of the keys, which even then could not be made to include all published diagnoses. The author has wisely avoided the making of new combinations

[7] MASSEE, GEORGE.—Redescriptions of Berkeley's types of fungi. Jour. Linn. Soc. Bot. **31**: 461–526. *pl. 16–18.* 1896.

[8] BARNES, CHARLES REID.—Analytic keys to the genera and species of North American mosses. Revised and extended by Fred DeForest Heald, with the cooperation of the author. Bull. Univ. Wis. Science Series **1**: 157–368, 1897. $1.00.

or the publication of new species, thinking it better that this compilation should not be cited in the future literature of taxonomy. For convenience, therefore, Renauld and Cardot's *Musci Americæ Septentrionalis* has been used as a basis, without any intention of expressing adherence to its nomenclature. Although the author emphasizes the fact that this work is a compilation, and does not regard it as of importance enough to be cited, and even feels compelled to apologize for it, nevertheless it represents such a critical insight of the group that bryologists will welcome it as both useful and important.—J. M. C.

MR. RAYNAL DODGE has issued a small manual of the pteridophytes of New England,[9] which will prove of service to New England students of the group. Following each one of the eight families is a brief account of the literature, and in the case of Isoetaceæ a considerable discussion of the taxonomic characters and the best methods of their recognition are given. A new Isoetes is described, *I. foveolata* A. A. Eaton; while some bibliographical confusion has been developed for *I. Eatoni* Dodge. In the manual before us this latter species appears as "n. sp.," while it is fully published, with plates, as a new species, in the BOTANICAL GAZETTE for January last. As Mr. Dodge's manual bears the date 1896, and the publication of the GAZETTE bears the date January 1897, ordinary usage will cite the former as the place of original publication, although the two publications are really synchronous, and the intention was to have the GAZETTE publication stand as the original one. —J. M. C.

THE THESIS of Edwin B. Copeland for the degree of doctor of philosophy, presented to the University of Halle and separately published, has been distributed. Dr. Copeland's subject is the influence of light and temperature on turgor. His experiments are thus summarized: 1. The turgor of the roots is not influenced by the illumination of the shoot. 2. Plants deprived of CO_2 show generally the same turgor as those which can assimilate. 3. In organs elongating in darkness turgor is lower than in control cultures, but it remains constant after growth ceases. No influence is exerted by the supply of food, whether abundant or not. 4. In those organs whose growth is less than normal under etiolation, the turgor is as high as usual or higher. 5. If plants are brought from light into darkness the turgor of the already grown parts is not altered in any characteristic manner with relation to the environment; but if the transfer be in the opposite direction a slow reaction of turgor of the stems is observable. From these experiments he concludes that the amount of turgor of roots, stems, and leaves is only remotely dependent on assimilation, and the substance which produces turgor cannot be used even

[9] DODGE, RAYNAL.—Ferns and fern allies of New England. 16mo., pp. viii + 52. Willard N. Clute & Co., Binghamton, N. Y. 1896.

to prevent the death of the plant from starvation. The various conditions of temperature or illumination which affect growth affect the turgor in exactly the opposite manner, so that if growth is retarded turgor rises, if growth is accelerated turgor falls. Turgor is regulated by, rather than regulates, the rapidity of growth.—C. R. B.

THE SEMI-ANNUAL REPORT of Schimmel & Co.,[10] for October 1896, gives special attention to the following topics: Almond oil, which is used extensively to perfume cocoanut oil soaps, is more certain to produce a white soap which will not discolor if it is free from hydrocyanic acid; otherwise most careful attention to temperatures is requisite in the process of manufacture and drying.——The regions of China yielding cassia oil have recently been traversed by O. Struckmeyer, and a map shows their location, which is chiefly in Kwang-si and Kwang-tung, south of the Si or West river, along the parallel of 23° N. and between 110° and 112° E. The oil is distilled from about 70 per cent. of leaves and 30 per cent. of twigs.——Bergamot, lemon and orange oils are discussed, especially in relation to adulterations.——Some interesting figures are given of the peppermint crop in the states of Michigan, Indiana, and New York, which will produce this season nearly 200,000 pounds of oil, of which Michigan produces about two-thirds. The largest peppermint field in the world is in Allegan and Pearl counties, about a mile long. ——The rose fields for which this firm is famous yielded the past season 265,000 kilos of roses, representing about 60 kilos of pure rose oil.—C. R. B.

NOTES FOR STUDENTS.

THE EARLIEST general presentation of the Caryophyllaceæ, that of De Candolle's *Prodromus*, can claim little merit. In fact, it is hard to say whether the treatment of the Alsineæ by Seringe, or of the genus Silene by Otth, shows the greater haste and superficiality. Far more scholarly was the work of Fenzl, who, in his admirable treatment of the Russian and Siberian Alsineæ, in his contributions to Endlicher's *Genera*, as well as in scattered and unfortunately fragmentary papers, shows the first critical insight into the order. Since the time of Fenzl, the most noteworthy contributors to our knowledge of the Caryophyllaceæ have been Rohrbach, Boissier, and Williams. Of these Rohrbach, during his short but active life, completed masterly monographs of Silene and Melandryum, and also prepared the Caryophyllaceæ for the *Flora Brasiliensis*, while Boissier in his *Flora Orientalis* has given very full and accurate descriptions of the numerous Mediterranean and oriental Caryophyllaceæ, his treatment of Silene being especially noteworthy. Of all living writers, however, Mr. Williams has doubtless the broadest

[10] Fritsche Bros., Leipzig and New York.

knowledge of the order, and his long expected monograph[11] of its most difficult genus is a very welcome addition to botanical literature.

The work, which fills nearly 200 octavo pages and recognizes 390 species, is regarded as supplementary to Rohrbach's *Monographie der Gattung Silene*. Species fully treated by Rohrbach are not redescribed, but only enumerated with brief bibliography. Species of later date, however, are well characterized in Latin. In its scientific aspect the work is decidedly British. The species and varieties are of the Benthamian sort, and there is no attempt at the elaborate varietal and formal subdivisions popular with and sometimes inordinately multiplied by continental monographers. Unfortunately *exsiccati* are not cited, which is a considerable defect. Surely the enumeration, under each species and variety, of a very few authenticated specimens would have added much more to the value than the bulk of the work.

One of the most interesting features of Mr. Williams' monograph is the attempt to transfer from Silene to Melandryum a considerable number of American and Asiatic species, chiefly those of Watson, Franchet, and Maximowicz. Recognizing the close affinities of certain large-flowered Silenes to species of Lychnis of the *L. dioica* type, various continental botanists have, since the beginning of the century, sought to unite them as an independent genus, Melandryum, or, as originally spelled, *Melandrium* Röhl. Various combinations of inconstant characters have been devised to limit this natural but ill-defined group, the strongest being the greater inflation of the calyx and the complete absence of the partial septation usual in the capsules of Silenes. While restricted as by Rohrbach to such species as *S. Baldwinii*, *S. Virginica*, etc., the genus Melandryum seemed to have, as to its American representatives, a tolerable habital unity, which gave it a certain *raison d'être*. Mr. Williams, however, by giving up all distinctions except the septation of the capsule, and attempting to apply this consistently, feels himself forced to transfer to Melandryum also a number of species of the characteristic Eusilene type, such as *S. Palmeri*, *S. Lemmoni*, *S. Bernardina*, *S. platyota*, *S. Shockleyi*, and *S. Thurberi*. Large genera, however, are seldom satisfactorily separated upon a single technical character wholly unsupported by habital or geographic differences, and such a separation seems especially ill advised when based, as in this case, upon the presence of a structural survival such as these partial septa, which exhibit all stages of obsolescence. But even if the desirability of such a generic distinction were admitted, the writer could not agree with Mr. Williams in excluding from Silene *S. Lemmoni* and *S. Bernardina*, both of which sometimes exhibit the partial septa, which, on the other hand, are sometimes wanting in *S. multinervia*, a species which Mr. Williams without hesitation retains in Silene. It

[11] WILLIAMS, FREDERIC N.—A revision of the genus Silene. Jour. Linn. Soc. **32**: 1–196.

may be noted that the tricarpellary Melandryum of Mr. Williams differs materially in its limitation from the genus of Röhling, Rohrbach, Garcke, and other continental writers.

Considering the extent of his task and the great number of forms treated, Mr. Williams has described few new species, and those made appear to rest upon strong characters. A few changes of name, which affect our North American species, may be noted. In *S. campanulata* Wats., Mr. Williams takes the commoner broad leaved form as the species and relegates the real type to a new made var. *angustifolia*, a sort of transfer which, if generally practiced, would lead in the end to a very indefinite varietal nomenclature. For, if the type of a species is to be taken, not as that form which was originally described, but that which any subsequent writer may (from abundance of material in his own herbarium or the statement of others) regard as the commonest, agreement will be difficult indeed. The name *S. Cucubalus*, restored by Rohrbach and to be accepted by strict followers of the "Kew rule," is rejected on a combination of what would seem very weak grounds; first, Cucubalus is a generic name, although *S. Armeria* is kept up without question. Then *S. Cucubalus* is said to be pedantic; why more so than various other longer and less euphonious binomials retained, does not appear. Furthermore, it is stated that there is a name, *Cucubalus inflatus* Salisb., three years older than *S. Cucubalus*. What this has to do with the case, it is difficult to understand, for being under another genus this cannot come under the "Kew rule," and if Mr. Williams adopts the continental practice of taking up the earliest specific name, he must be aware that in this case there are earlier ones than that of Salisbury. Finally, the doctrine of usage is brought in to support *S. inflatus*, yet Mr. Williams does not hesitate at another point in his work to replace the well known North American *S. verecunda* by *S. Behrii* Williams, an elevated varietal name never current in any flora.

In the arrangement of species it is hard to see why *S. monantha* Wats., which, if not actually a variety of *S. Douglasii*, must be a near ally, is relegated to § GASTROSILENE, with which it has no close affinity. In a preliminary paper upon the North American Sileneæ, the present writer some years ago suggested that *S. purpurata* Greene, of which no authentic material was then at hand, "appeared to be near *S. Scouleri*." It is accordingly a surprise to find *S. purpurata* placed under *S. Scouleri* "*ex* B. L. Robinson," while as a matter of fact the type of *S. purpurata*, kindly loaned by Professor Greene, has proved on examination identical with the Siberian *S. repens* Patr. *S. Hallii* Wats., upon which (together with the ill-starred *S. purpurata* Greene) Mr. Williams bases his *S. Scouleri* var. *costata*, differs from *S. Scouleri* in range, habit, and inflation of the calyx, so that its specific separation by Dr. Watson seems fully warranted.

In giving geographic ranges in the New World, Mr. Williams is, to put it mildly, very un-American. For instance, to *S. Menziesii* the following extraordinary habitat is assigned: "The mountains of N.-W. America from Oregon Territory; Vancouver's Island, the Rocky mountains, and the Black Hills as far as Slave Lake; and in the United States from Vancouver's Island to Colorado, South California, and New Mexico." *S. Scouleri*, however, seems to have received a still more remarkable range, its *northern* and *western* limits being given as Vancouver's Island and British North America, and its *eastern* and *southern* limits as the Caucasus. The writer would express some doubt as to the identity of the Asiatic specimens, but even if this point is waived, it is still evident that Mr. Williams has gone around the world the wrong way! A similar lapse of clear thought is shown by the highly infelicitous name "subacaulescens" for a somewhat caulescent form of the usually stemless *S. acaulis*.

However, the few points for criticism here enumerated, and some others which might be mentioned, affect only a small part of this generally admirable paper, and Mr. Williams is to be congratulated upon the completion of a difficult monographic task and the production of a useful work abounding in clear distinctions and excellent descriptions.— B. L. ROBINSON, *Harvara University*.

MR. W. C. WORSDELL has studied the anatomical structure of the stem of *Macrozamia Fraseri*,[12] a genus which has not been investigated heretofore. Our previous information concerning the stem structure of cycads has been derived from studies of the genera Cycas, Encephalartos, and Stangeria. In these genera certain so-called "anomalous" structures were discovered which have excited considerable interest, especially in view of their possible phylogenetic significance. The examination of a single old decaying stem of a single species of Macrozamia may not form a proper basis for much safe generalization, but Mr. Worsdell has found enough in it to be worthy of record. A striking feature of the stem structure is the occurrence in the pith of a dense network of vascular bundles, a condition of things heretofore recorded only in Encephalartos. This anastomosing system traverses the pith in every direction, the course of each bundle apparently being determined by the fact that it is a constant attendant of a mucilage canal, which is a branch of a similar anastomosing network of mucilage canals. The orientatation of these vascular bundles is by no means regular with reference to the periphery of the stem, but is determined by the mucilage canals, toward which the phloem is constantly directed. As the canal twists and bends through the pith the bundle accompanies it, appearing first on one side and then on the other, sometimes giving rise to curious contortions of the vascular elements. Certain smaller branches of this vascular network

[12] Ann. Bot. 10:601–620. *pl. 27, 28.* 1896.

were observed to enter the medullary rays and pass outwards, accompanying mucilage canals, the xylem and phloem elements joining the corresponding regions of the primary zone, the mucilage canals passing on to join the canal system of the cortex. As would be expected, this vascular system of the pith is strictly cauline, the mucilage canals appearing unattended near the apex, while farther down the accompanying vascular elements are gradually differentiated.

Another cycadean peculiarity, known heretofore in Cycas and Encephalartos, is the occurrence of a succession of secondary zones of vascular strands outside of the primary leaf-trace zone, formed by successive meristem zones developed in the pericycle. In Macrozamia these secondary zones are strongly developed, the first one being as prominent as the normal one, the subsequent ones rapidly diminishing in size. The strands of the secondary zones have the same orientation as those of the primary zone, the xylem of each zone abutting almost directly upon the phloem of the next inner one. What Mr. Worsdell apparently regards as a capital discovery, however, is the detection of an occasional "tertiary cambium," by which he means that between the primary and first secondary zones, or between successive secondary zones, small intermediate bundles are occasionally developed. The remarkable thing about them, however, is their reversed orientation, the xylem being directed outwards, towards the xylem of the outer zone. This position occasionally results in an appearance so suggestive of a concentric bundle that the author associates with it the well known cortical concentric bundles of Cycas, and suggests a possible method of the derivation of the collateral bundle from the concentric. He sees in these "anomalous structures" of cycadean stems the "remnants of some ancient structure once common to a large group of plants," this ancient structure consisting of "rings or layers of concentric vascular strands." Later, the meristem of the inner portion of each concentric strand gradually became less and less functional, that of the outer portion became more and more active, and the collateral bundle was developed. These rings of ancient concentric bundles are still seen in the cortex of Cycas, and the reduced inner portions of the concentric bundles are seen in the small intermediate bundles of Macrozomia with reversed orientation. This hypothesis will be tested, not only by further examination of living cycads, but also by an investigation of the structure of numerous fossil forms which are either cycads or show cycad affinities.—J. M. C.

DR. D. H. CAMPBELL a year ago described in this journal[13] a new genus of liverworts, to which he gave the name *Geothallus tuberosus*. It is a low type, and agrees with Sphærocarpus more nearly than with any other known form. These two genera, along with Riella and Thallocarpus, constitute the lowest group (Anelatereae) of the anacrogynous Jungermanniaceae, all agree-

[13] BOT. GAZ. **21**:9–13. *pl. 2.* 1896.

ing in the absence of perfect elaters, which are replaced by thin-walled chlorophyll-bearing cells. Dr. Campbell has now published an account [14] of the development of his new genus, showing that it agrees with Sphærocarpus in the form of the apical cell and in the general position and structure of the sex organs, particulars in which both genera resemble Riccia; and that it differs from it in its much more massive thallus, in its second division in the antheridium and the massive stalk of that organ, in its sessile archegonium and consequent deeper penetration of the foot of the embryo into the thallus, in the large size and complete separation of the smooth spores, and in the development of true leaves and tubers. In the judgment of the author Sphærocarpus remains the most primitive type, and Geothallus is intermediate between it and forms like Fossombronia.—J. M. C.

THERE HAS BEEN much discussion as to the origin of the droplets of sweet secretion which fall from trees in midsummer, sometimes in such abundance as to cover the pavements, and especially the twigs and lower leaves. In 1884 Boudier concluded that it was wholly of animal origin. In 1891 Büsgen in his important memoir on honeydew seemed to support this view, though he discussed only the sweet secretion produced by insects. But various botanists, apiculturists, and entomologists had pointed out clearly a twofold origin of honeydew. M. Gaston Bonnier has reinvestigated the question both by observation and experiment. He comes to these conclusions.[15]

Honeydew, while more commonly the product of Aphidæ and Coccinellidæ, is also of plant origin, as may be demonstrated by direct observation of the sweet droplets as they appear at the stomata. The animal honeydew appears during the day, the plant during the night, with a maximum at daybreak. The conditions which favor its production are cool nights and hot dry days. Increased moisture in the air and cloudiness also favor it, other things being equal. Severed branches plunged in water, with the leaves shaded and in a saturated atmosphere, will produce honeydew at the stomata, even when those on the tree are not doing so. The plant honeydew approaches in chemical composition more nearly the nectar of flowers than it does that of aphides.—C. R. B.

THE Protophyta have received a new systematic treatment, the result of recent study by Professor C. E. Bessey.[16] He divides them into the two orders Cystiphoræ and Nematogenæ, composed of unicellular and filamentous forms respectively. Further, the "bacteria" are not considered a distinct family, the author not regarding the hysterophytic habit, as contrasted with

[14] Ann. Bot. **10**: 489–510. *pl. 24, 25.* 1896.

[15] Revue général de Botanique **8**: 1–22. 1896.

[16] The systematic arrangement of the Protophyta. Amer. Nat. **31**: 63. 1897.

holophytic, of so great taxonomic value as differences of structure. Green and colorless species should in some cases be put together, even within the limits of the same genus, as the author does in the case of Schizothrix, for example. Six families are recognized, the "bacteria" occurring in three of them, but the great majority are included in the second, the Oscillariaceæ.—J. G. C.

In the continuation of his studies upon flowers and insects,[17] Mr. Charles Robertson has presented results obtained from investigations of Hepatica, Asimina, Podophyllum, Solea, Euonymus, Æsculus, Astragalus, Stylosanthes, Gymnocladus, Spiræa, Gillenia, Viburnum, Symphoricarpos, Aster, Silphium, Heliopsis, Rudbeckia, and Cacalia.

In this same connection it may be noted that Mr. J. Lloyd Williams[18] has called attention to the intoxication of bumblebees by the nectar of certain "capitulate" plants (Centaurea and Carduus), and suggests that their helpless rolling covers them effectually with pollen, which upon their recovery is carried to other heads.—J. M. C.

Items of taxonomic interest are as follows: Mr. E. B. Uline has published a revision of the Mexican and Central American species of *Dioscorea*.[19] Mr. George Massee has redescribed many of the Berkeley types of fungi.[20] Mrs. E. G. Britton has enumerated[21] the Bolivian mosses collected by H. H. Rusby in 1885–6, among which are 42 species either new or previously undescribed. Mr. E. P. Bicknell has published an account of the North American species of *Agrimonia*,[22] in which he shows that *A. Eupatoria* L., not known as an American plant, has long given its name to a group of related species, five of which he characterizes, reviving old names in every case excepting for *A. Brittoniana*. Dr. T. F. Allen has described three new species of *Nitella*,[23] two from Japan, and one from Indian Territory. Professor E. L. Greene, in his last fascicle of studies,[24] discusses *Cardamine* and *Dentaria*, suggesting a new definition of the genera; proposes a new cruciferous genus, *Schœnocrambe*, based upon plants that have been referred variously to Nasturtium, Sisymbrium, and Erysimum; considers the generic name *Erysimum* untenable and substitutes for it the name *Cheiranthus*, renaming the species; discusses further the acaulescent violets; and con-

[17] Trans. St. Louis Acad. Sci. **7**: 151–179. 1896.
[18] Jour. Bot. **35**: 8–11. 1897.
[19] See under Minor Notices, p. 132.
[20] See under Minor Notices, p. 133.
[21] Bull. Torr. Bot. Club **23**: 471–499. 1896.
[22] Bull. Torr. Bot. Club **23**: 508–523. *pl. 282–283*. 1896.
[23] Bull. Torr. Bot. Club **23**: 533–536. *pl. 284–286*. 1896.
[24] Pittonia **3**: 115–149. 1896.

structs two new asteroid genera of Compositæ, *Oreastrum* and *Leucelene*, the latter founded upon *Diplopappus ericoides* T. & G. Dr. E. Koehne has published an account of the genus *Philadelphus*,[25] of which thirty-three species are recognized, twenty of which belong to the flora of North America and Central America. A new species from Mexico is described, and two from "western North America," while *P. grandiflorus* of American authors is identified with *P. latifolius* Schrad. The species hybridize freely, and a large number of such cases is recorded. Mr. William Fawcett has published a synoptical arrangement of the Melastomaceæ of Jamaica,[26] a family represented by eighteen genera and over fifty species. M. A. Franchet continues his publication of numerous new species of Chinese Compositæ, among which there recently appears a new genus, *Stereosanthus*,[27] apparently intermediate between Inuloideæ and Senecionidæ. A new Californian *Trifolium* has been described by Mr. W. C. Blasdale.[28] Dr. W. A. Setchell has published a second fascicle of his "Notes on Cyanophyceæ."[29] A plate and an account of *Sisyrinchium Californicum*, growing in Ireland, has been published by Mr. A. B. Rendle.[30] Students of fresh water algæ will welcome the appearance of the first installment of Welwitsch's African collection, by W. West and G. S. West,[31] among which are numerous new species. Mr. L. H. Pammel and Professor F. Lamson-Scribner have published notes upon a collection of grasses collected in 1895 between Jefferson, Iowa, and Denver, Colo.[32] Mr. L. H. Pammel has also published some notes upon the flora of western Iowa.[33] Mr. F. L. Fernald has published an account, with plate, of *Aster tardiflorus* L.,[34] previously discussed by him in this journal.[35]—J. M. C.

AT ONE TIME the anatomical changes induced in climbing organs by the pressure of the support, and the pull exerted by the weight of the plant, were supposed to be coincident or causal to curvature, instead of consequent upon it. Tendrils, climbing branches, climbing hooks, and twining stems have been previously examined, and Dr. von Derschau has recently extended the work to include a number of twining petioles.[36] Twining petioles are not so

[25] Gartenflora **45**: 450–461. 1896.
[26] Jour. Inst. Jam. **2**: 268–277. 1896.
[27] Jour. de Botanique **10**: 384. 1896.
[28] Erythea **4**: 187. 1896.
[29] Erythea **4**: 189–184. 1896.
[30] Jour. Bot. **34**: 494. 1896.
[31] Jour Bot. **35**: 1–7. 1897.
[32] Proc. Soc. Prom. Agric. Sci. 1896.
[33] Proc. Iowa Acad. Sci. **3**: 106–135. 1895.
[34] Garden and Forest **10**: 14. 1897.
[35] BOT. GAZ. **21**: 275. 1896.
[36] Einfluss von Kontakt und Zug auf rankende Blattstiele. Inaugural-Diss., 36 pp. 2 col. lith. plates. No date. Leipzig.

highly irritable as tendrils, though they approach the less sensitive forms in sensitiveness. Petioles of Tropæolum encircled a support in five hours, Lophospermum in eleven hours, Clematis and Solanum in fourteen hours. The contact curvatures are often opposed by the heliotropic reaction of the leaf. Under such conditions a petiole of Lophospermum consumed forty hours in encircling a support.

The morphologically upper side of the petioles of Solanum, Lophospermum, and Tropæolum, and the lower side of Clematis showed the greatest degree of irritability.

In his comparisons the author assumes a latent period of fifteen to thirty minutes for tendrils, which in reality react in ten to fifteen seconds.

The limited transmission of impulses in tendrils is duplicated in petioles. Curvatures, according to the author's measurements, are due to an accelerated growth of the convex side. The portion of the petiole in contact with a support undergoes great increase in thickness, and if the mechanical system is in the form of a crescent or open ring, it is closed.

Stretching tension exerts an influence upon twining petioles similar to that of typical organs. Stretching tension acting upon the encircling part of the petiole in some instances induced in some species an exaggeration of the contact effect, and in others a diminution.

This paper has but recently reached the hands of the reviewer, and bears no date of imprint. Reference is made to a work published in 1892, and the reader has no means of determining the time of publication within five years.—D. T. MacDougal.

NEWS.

DR. KIENITZ-GERLOFF has been called to a professorship in Weilburg.

PROFESSOR F. A. HAZSLINSZKY, one of the well known Hungarian mycologists, died at Eperies, Hungary, on the 19th of November last.

A BIOGRAPHICAL SKETCH of the late Henry Trimen, with portrait, appears in the *Journal of Botany* for December (1896), prepared by the editor, Mr. James Britten.

A SECOND ISSUE of Bailey's *Survival of the unlike* is about ready. A few minor alterations have been made and a fuller statement given to the concluding paragraph of the first essay.

THE TITLE of "professor" has been conferred upon Dr. Karl Müller, of Halle, the editor of *Natur*, and better known to American readers as the author of the *Synopsis Muscorum*, and many other works and papers on bryology.

A GARDEN SCHOLARSHIP is to be awarded by the Director of the Missouri Botanical Garden, Dr. Wm. Trelease, before April first. Applications must be in before March first, and the preliminary examination will be held at St. Louis March 9.

A REVISED EDITION of Wright's "Guide to the organic drugs of the U. S. Pharmacopœia of 1890" has been issued by Eli Lilly & Co. of Indianapolis. It contains much additional material, and is of interest not merely to pharmacists, but also to botanists who are interested in the medicinal properties of plants. It may be had from the firm for a two-cent stamp, or, bound in leather, for twenty-five cents.

A VERY INTERESTING ACCOUNT of cryptogamic botany in Harvard University, from 1874 to 1896, has been prepared by Dr. W. G. Farlow. The account concludes with a list of contributions from the cryptogamic laboratory, containing thirty-seven numbers, to which are added eight unnumbered papers which contain the results of work done by their authors while studying in the laboratory, besides the numerous papers by Professor Farlow himself.

MRS. GRAY has completed the mounting of the autograph letters of various botanists which Dr. Asa Gray preserved from his voluminous corres-

pondence, numbering more than eleven hundred. With the letters, whenever possible, an engraving or photograph of the writer has been mounted. Some of the autographs are extremely rare, and the painstaking care which Mrs. Gray has bestowed upon preparing and mounting the letters, has increased the value of the collection many fold.

IN PROSECUTING the work of "Experiment Station Extension" under the Nixon law in the State of New York, Professor Bailey has conceived and is publishing a series of leaflets for use in the rural schools. These leaflets are intended to be put into the hands of teachers, or even of pupils, as suggestions for object lessons about common things. Number 1 is dated December 1, 1896, and is entitled "How a squash plant gets out of the seed," and is illustrated by fourteen admirable outline drawings. The idea is a good one.

HEINRICH BEHRENS suggests a new method of preserving juicy fruits, fleshy parts of plants, fungi, etc.[1] The parts are dipped when the surface is air-dry into a warm 5 per cent. solution of gelatine. If the gelatine does not adhere, the object is first dipped in 70 per cent. alcohol and then immediately into the gelatine. After cooling the object is dipped into a mixture of twenty parts of formalin (40 per cent. formaldehyde) and fifty parts water. An insoluble layer of gelatine is thus formed, destroying all adherent putrefactive and fermentative germs, and preserving the watery parts in their natural form and color.

MR. AUGUSTINE HENRY, of Mengtse, China, has just published[2] an interesting account of Chinese "soap trees." The fruits of these trees are in common use among the Chinese for washing purposes, in spite of the importation of alkaline soaps. Little is known concerning the chemical nature of the fruits which give them such useful properties, but it is assumed that they contain saponin. Mr. Henry finds that the soap trees belong to the Sapindaceæ and Leguminosae, and that all the genera are represented in America excepting Pancovia. The list of trees whose fruits are so used throughout China contains twelve species, eight of which are species of Gleditschia, and the others species of Sapindus, Pancovia, Gymnocladus, and Acacia.

UNDER A new law, announcement is made by the United States Department of Agriculture that the serial, scientific, and technical publications of the department are not for general distribution. All copies not required for official use are turned over to the Superintendent of Documents, who is empowered to sell them at cost. All applications for such publications should therefore be made to the Superintendent of Documents, Union Build-

[1] Zeits. f. angewandte Mikroskopie **2**: 36. 1896. Cf. Bot. Centralbl. **68**: 286. 1896.

[2] Amer. Druggist and Pharm. Record, **29**: 317. 1896.

ing, Washington, D. C. He is not, however, allowed to sell more than one copy of any public document to the same person, and remittance should always be made to him and not to the Department of Agriculture. Do not send checks or stamps.

THE PUBLISHER of Engler & Prantl's *Natürlichen Pflanzenfamilien* (Wilhelm Engelmann, Leipzig) announces that parts II, III, and IV, treating the phanerogams, are complete with the exception of the conclusion of Labiatæ, Umbelliferæ, and Cornaceæ, and the supplements including genera added during 1896 to the families already published. Harm's Cornaceæ is in press; Briquet promised to complete the Labiatæ by the close of 1896, as did also Drude the Umbelliferæ. Engler is preparing the supplementary parts. The prospect is therefore that the phanerogams will be completed during the first half of 1897. In order to enable subscribers to use these parts conveniently at once a separate index for phanerogams and cryptogams will be issued. A capable bibliographer is already at work on the index. This course, although objectionable, has been determined upon because of the necessarily slow progress of the cryptogamic parts. The preparation of the algæ and fungi progresses rapidly and will probably be finished by the close of this year, but it is doubtful whether the bryophytes and pteridophytes can be ready before 1898.

THE COLLECTING SEASON of the Mexican Botanical Club for 1897 will open March 1. The territory they propose to explore will embrace the states of Guerrero, as far south as Acapulco, Michoacan, Jalisco, Colima, and Territory of Tepic, probably as far north as San Blas. This is a most picturesque and fertile country, ranging from sea level to 14,000 feet elevation, interspersed with numerous valleys, deep cañons, rugged mountains, active volcanoes, and abundant streams of water. Under their careful system of explorations they should reap a rich harvest of economic plants, and new varieties valuable for cultivation and investigation. As a result of their operations, we look for new and rare varieties of orchids, palms, ferns, etc., which they propose to mail weekly to members directly from the field in growing condition. They will also be well equipped with cameras for photographing scenery, and especially plants, unmounted copies of which will be given to each member. The work will be again under the direct management of Mr. Wm. Brockway, Maravatio, Mexico. We understand that the club is desirous of securing a few more members at once, and full information may be obtained by addressing him or Professor L. N. Bailey, Ithaca, N. Y.